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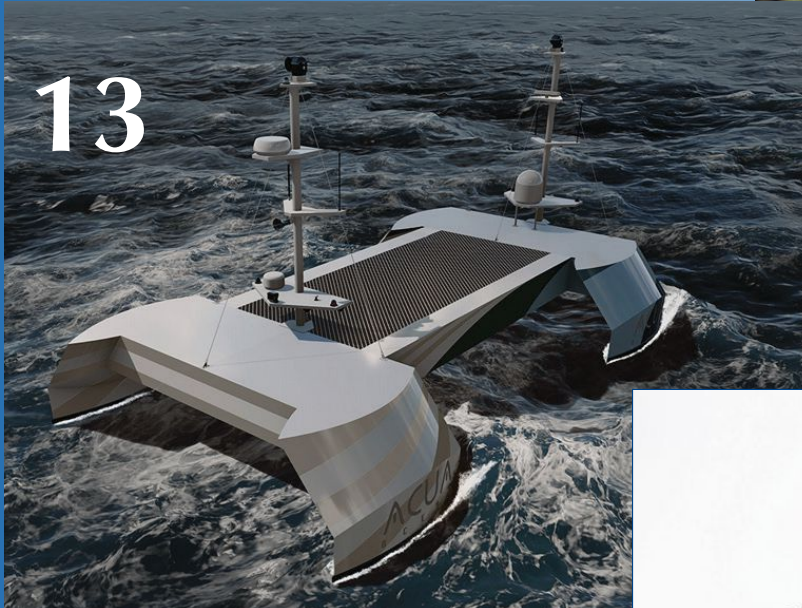
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COVER IMAGE

A view of Miros's cloud-enabled Oil Spill Detection (OSD) system in use, September 2024. OSD allows secure real-time data sharing for 24/7 monitoring, swift decision making, quick response and tamper-proof reporting. The solution integrates live OSD data with local real-time sea conditions, enhancing situational awareness for all stakeholders. Sea state measurements from Miros ensure accurate ocean insights. Weather layer by Windy. (Credit: Iris Janda, Miros)

NEXT MONTH

Next Month: Connectors for maritime domain awareness systems ... ROVs for mine countermeasures ... ROVs for naval threat survey and asset maintenance ... Subsea edge processing systems with integrated navigation for defense ... Applications for AI and radars in deterministic prediction.

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)) Citizen Science Grants. The U.S. Department of Commerce and NOAA announced a \$600,000 funding opportunity for members of the public to conduct science that helps fisheries and fishing communities prepare for climate change. These funds are made possible by the Inflation Reduction Act, the largest climate investment in U.S. history. NOAA Fisheries is seeking proposals for citizen science projects, marking a unique collaboration with members of the general public who will actively participate in the scientific process, alongside researchers, to address real-world questions. These projects aim to produce information that could help to address data gaps in assessing the health of marine fish stocks or how fisheries and fishing communities may be impacted by changing environmental conditions. By harnessing the power of citizen science, NOAA seeks to expand the breadth and depth of observations available, accelerating data collection and delivery. These funds are expected to support three to eight different projects at approximately \$75,000 to \$200,000 per project during fiscal years 2025 and 2026. This research will help increase the number and types of observations NOAA can make, accelerating the collection and delivery of data and contributing to timely and accurate management decisions for vulnerable species and sustainable fisheries. Applications can be submitted at grants.gov by November 4, 2024. Projects should be designed with scientific quality and data credibility as core considerations. The grants are available to a variety of applicants, including individuals, academic institutions, for-profit and nonprofit organizations, state governments, and tribal and local organizations.

)) Crowdsourced Bathymetry Dashboard. FarSounder has released the CSB Data Explorer at: <https://mycsb.farsounder.com>. This web-based platform enables contributors of CSB (crowdsourced bathymetry) data to see where they've made contributions and gauge their support of the CSB community (*Sea Technology*, January 2024). The simple-to-use dashboard provides statistics highlighting the value of individual contributions toward mapping the global ocean. This not only enables contributors to better understand where and how much they have donated but also facilitates the recruitment of other contributors via streamlined functionality to share their stats on social media. Additionally, in an effort to provide more motivation through gamification, contributors can compare their contributions to the overall FarSounder fleet's contributions and view the entire International Hydrographic Organization's (IHO) CSB database on top of a global map. The CSB Data Explorer was created in partnership with the International SeaKeepers Society, the IHO and The Nippon Foundation-GEBCO Seabed 2030 Project.

)) Arctic Sea Holds Promising Antibiotic Microbes. Seventy percent of all currently licensed antibiotics have been derived from actinobacteria in the soil, and most environments on Earth have not yet been prospected for them. Thus, focusing the search on actinobacteria in other habitats is a promising strategy, especially if this were to yield novel molecules that neither kill bacteria outright nor stop them from growing, but only reduce their virulence, or capacity for causing disease. This is because it is hard for targeted pathogenic strains to evolve resistance under these conditions, and such antivirulence compounds are also less likely to cause unwanted side-effects. A new study published in *Frontiers in Microbiology* focuses on the discovery of a compound that inhibits enteropathogenic *E. coli* (EPEC) virulence without affecting its growth, and a growth-inhibiting compound, both in actinobacteria from the Arctic Ocean. The researchers have developed new methods that can test for the antivirulence and antibacterial effect of hundreds of unknown compounds simultaneously. They targeted an EPEC strain that causes severe, sometimes deadly, diarrhea in children under five, especially in developing countries. EPEC causes disease by adhering to cells in the human gut and injecting "virulence factors" into the host cell to hijack its molecular machinery, ultimately killing it. The tested compounds were derived from four species of actinobacteria, isolated from invertebrates sampled in the Arctic Sea off Svalbard during an expedition of the Norwegian RV *Kronprins Haakon* in August 2020. The researchers found two unknown compounds with strong antivirulence or antibacterial activity: T091-5 in the genus *Rhodococcus* and T160-2 of *Kocuria*. The next steps are the optimization of the culture conditions for compound production and the isolation of sufficient amounts of each compound to elucidate their respective structures and further investigate their respective bioactivities.

)) First Vessel Reaches Uncharted Fjord. The GEOEO North of Greenland 2024 Expedition, organized by the Swedish Polar Research Secretariat aboard the icebreaker *Oden*, has made history as the first vessel to reach the remote Victoria Fjord in North Greenland. Data acquired on the expedition will contribute to The Nippon Foundation-GEBCO Seabed 2030 Project, which seeks to create a complete, publicly available map of the entire ocean floor by 2030. The vessel left the Port of Thule, the world's northernmost deepwater port, at the beginning of August. Despite facing multiyear sea ice and pressure ridges, the vessel, with 40 researchers on board hailing from Sweden, the U.S., Denmark, Australia and Switzerland, was successful in reaching Victoria Fjord late August. The primary geographical focus region of the expedition is the Victoria Fjord in order to assess how much and how fast the ice sheet in North Greenland can contribute to the global sea level rise. Among the broad scientific goals of GEOEO are: to investigate the interaction between ecosystem community composition, anthropogenic dynamics and climate fluctuations; to map the remote ocean frontier; and numerical modeling of the ice-ocean-atmosphere-geodynamic system. **ST**

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Moving Toward Marine Net Gain

The ocean generates half of the oxygen that we breathe and absorbs 25 percent of all CO₂ emissions. Climate change and human activities are affecting ocean health and the vitality of marine habitats. Warming waters, acidification, and pollution from land circulating into and through the ocean are degrading marine ecosystems in areas around the world. Yet the possibility exists for marine habitat restoration to safeguard ocean health, which is crucial to the global economy.

In accordance with the United Nations (UN) Sustainable Development Goals, the concepts of biodiversity net gain (BNG) and marine net gain (MNG) are gaining traction. Marine habitat restoration could contribute to MNG, carbon sequestration, port decarbonization and shoreline protection, as well as enabling a continuing source of food and livelihoods for coastal communities.

MNG, a relatively new concept under discussion in the U.K., aims to enhance marine habitats through development projects that move beyond traditional methods of merely minimizing harm to the environment. Under the MNG approach, similar to BNG, developers would be required to deliver measurable improvements to marine habitats to compensate for any loss to these habitats that may occur as a result of their projects.

MNG efforts also offer an opportunity for carbon offsetting, which allows individuals, organizations and/or governments to compensate for their carbon emissions by investing in projects that reduce or remove greenhouse gases from the atmosphere.

Ports are an ideal place to start because anthropogenic activities such as fishing and shipping have significantly impacted marine habitats around their infrastructure. As we explore the feasibility of reviving such habitats, there are benefits for biodiversity conservation and carbon offsetting. Direct engagement with these industries can alleviate environmental pressures by promoting sustainable practices.

Targeted restoration efforts that prioritize the health of native species and the removal of invasive species should be the focus. By revitalizing subsea habitats in the waters around ports, such as seagrass meadows and coral reefs, we can create essential corridors of thriving marine life. Coral reefs and seagrass meadows serve as natural buffers to storms while providing habitat for species that serve as critical elements of coastal economies. Revitalizing these ecosystems can also contribute to carbon offsetting by sequestering substantial amounts of carbon dioxide in coastal waters.

While the promotion of MNG and carbon offsetting through marine restoration projects holds great promise, it comes with challenges, such as securing funding. The success of these projects also depends on accurate measurement and long-term monitoring of the restored habitats to ensure sustainability.

Success relies on public and private sector collaboration. Governments play a crucial role in creating and enforcing regulations to protect marine ecosystems, incentivizing restoration efforts, providing financial support, and facilitating partnerships. NGOs, including research institutions, help to advance the science and practice of marine restoration via research, raising awareness, and advocating for policy changes. The private sector can make a significant impact by integrating MNG and carbon offsetting into business strategies. By practicing responsible coastal development, companies can contribute to the health of the marine ecosystems that surround and support their growth. Collaborative efforts can help build a sustainable future: www.tunley-environmental.com/en/white-papers/restoration-for-marine-net-gain. **ST**

SEA TECHNOLOGY® 2024

JANUARY

Annual Review & Forecast

****EUROMARITIME 2024**, January 30-February 1, Marseille, France

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

****Oceanology International 2024**, March 12-14, ExCel, London, U.K.

MARCH

Electronic Charting/Vessel Management/ Ports & Harbors/Dredging/Homeland Security

****UDT 2024**, April 9-11, ExCel, London, U.K.

****OCEANS 2024 Singapore**, April 14-18, Singapore

****XPONENTIAL 2024**, April 22-25, San Diego, CA

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

****Offshore Technology Conference**, May 6-9, Houston, TX

MAY

Communications, Telemetry, Data Processing

JUNE

Seafloor Mapping/Sonar Systems/Vessels

****Sea Technology supports these shows**

BONUS INFORMATION

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| • Contracts | • Meetings | • People |
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JULY

Deck Gear, Cable, Connectors, Power Systems & Salvage

****IMAGE 2024**, August 25-30, Houston, TX

AUGUST

Ocean Resources Development & Coastal Zone Management

****OCEANS 2024 Halifax**, September 23-26, Halifax, Canada

SEPTEMBER

Geophysical Exploration/Seafloor Engineering

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

****EURONAVAL 2024**, November 4-7, Paris, France

****CLEAN GULF**, November 18-20, San Antonio, TX

****MAST Australia 2024**, November 19-21, Adelaide, Australia

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Biodiversity Monitoring

eDNA Tech Can Protect Business and the Environment

By Ben Goymer

COP15's historic deal to halt biodiversity loss by 2030 marked the beginning of global efforts to stop human-induced extinction and restore the planet's degraded ecosystems, defined under the Kunming-Montreal Global Biodiversity Framework. With COP16 fast approaching in November, countries will be expected to take appropriate action and report back with national biodiversity strategies and action plans, and implementation of national regulatory frameworks will likely follow.

On a corporate level, recommendations such as the 2023 Taskforce on Nature-related Financial Disclosures (TNFD) were established to help businesses conduct financial assessments of their ecosystemic footprint and report on their nature-impacted assets. TNFD has begun altering many industries as it supports broader sustainability goals outlined by the UN's Global Biodiversity Framework. In the maritime sector, it has started to influence how projects and activities are planned and financed and, perhaps more importantly, how they are monitored.

For activities such as offshore wind development, submarine cable installation and coastal data collection, monitoring nature's impact and furthering conservation efforts will be increasingly prioritized, regulated, and required to preserve global natural capital. Understanding the baselines that marine companies are working with and their current impact on natural resources will allow them to get ahead and enhance their preparedness when regulations come into place. To do this, establishing nature reporting and monitoring processes early on is vital. Failure to do so poses an economic risk with fines subject



By analyzing a water sample using eDNA technology, scientists can detect the presence of various species in a particular environment.

to country-specific regulations and a risk of reputational damage as nature is increasingly becoming a top priority that is closely examined by investors and the public.

Reporting on nature requires a significant amount of data, which has historically been difficult to collect. While climate and energy data collection is well established, with systematic and global efforts utilizing advanced satellite and remote sensing technologies, this is not the case for biodiversity data. The long history of climate and energy data collection has enabled the standardization of methodologies and highly automated analysis due to the large volumes of data available, but long-term biodiversity monitoring lacks data and metrics.



eDNA surveys were used to monitor native, white-clawed crayfish (pictured) and invasive signal crayfish in U.K. rivers.

Biodiversity Knowledge Gaps

Biodiversity data collection has historically been geographically and taxonomically biased, with significant gaps resulting from inconsistent sampling across different regions. In the case of marine environments, larger, charismatic species are usually better understood than microscopic or deep-sea species, even though these lesser-known organisms are crucial indicators of ecosystem health.

Traditional methods, such as trawling, require specialized vessels and personnel to carry out sampling, are weather-dependent, and are geospatially limited. In the offshore sector, for example, traditional methods cannot provide the full picture of biodiversity data as ecosystems surrounding arrays of floating or fixed turbines in wind farms are hard to access with the large vessels required, creating additional health and safety concerns.

Innovative solutions to these biodiversity data collection challenges are increasingly being developed to spark change in this area. Technologies such as bioacoustics and environmental DNA (eDNA) sampling and analysis are enabling organizations operating in the marine space to better understand marine biodiversity. These tools have given scientists a much more accurate picture of what's happening below the surface compared to traditional methods, enabling them to take effective action.

Development of eDNA

eDNA is an innovation that has drastically changed the biodiversity monitoring sector. This technology detects traces of genetic material naturally left behind by

organisms, enabling broad species localization from a single water sample, identifying 70 percent more species than traditional methods. eDNA samples can be completed by staff on site with minimal training, as they only require the collection of a water sample from the site of interest.

Innovation within this space over the last several years has further improved eDNA's accessibility. Autosamplers now enable eDNA collection without the need for labor-intensive, vessel-based campaigns.

Once collected and analyzed, metrics can be gathered from the data, making it easy to track the progress of the environment in question, comparing variability from samples within the same location and understanding how ecosystems are changing over time. The cost of this technology is significantly lower than that of using a specialized vessel and an on-site ecologist, which can cost up to \$65,000 per day, making eDNA a more cost-effective option for regular biodiversity monitoring.

Ongoing biodiversity tracking with environmental impact assessment platforms will enable companies to prove a net gain in their contribution to nature. This will help build our understanding of the health and biodiversity of our seas, bridging a wide gap in marine biodiversity monitoring with scalable and simple data sampling that will be increasingly required of corporations operating in the marine sector.

Preservation of Nature Capital

Maritime industries depend heavily on the health and proper functioning of our marine ecosystems. The

ocean's annual output of goods and services was estimated at \$2.5 trillion in 2015, placing its overall value at \$24 trillion, according to the World Wildlife Fund. In the U.S. alone, commercial and recreational saltwater fishing generates \$253 billion in sales impacts, contributing \$117 billion to the U.S. GDP, according to a recent NOAA report.

Additionally, maritime sectors such as offshore wind are experiencing significant growth, especially in the U.S. and Canada. This growth is supported by the U.S. government's Offshore Wind Energy Strategy, announced in March 2023, which aims to harness offshore wind as a reliable energy source. This strategy promises well-paying union jobs, the revitalization of coastal communities, and the positioning of the U.S. as a leader in offshore wind energy.

Given the increasing economic dependence on marine environments, it is crucial for companies operating in these sectors to protect natural capital effectively. Implementing low-cost, innovative biodiversity monitoring technologies is not only environmentally indispensable but also economically sensible. Minimizing the impact of marine activities on all species ensures the sustainability and viability of these industries.

The Rise of Nature Regulation

With new regulations on the horizon and clear government signposting emphasizing the importance of biodiversity protection and restoration, it is more crucial than ever for companies to take part in protecting our oceans. Aligning with these regulations will not only ensure compliance but also safeguard companies' interests as these requirements become mandatory.

The importance of this issue has already been highlighted through initial frameworks and bills implemented across North America. In June 2024, for example, Canada introduced a Nature Accountability Bill to align and enforce its 2030 Nature Strategy, aiming to halt and reverse biodiversity loss in alignment with the Global Biodiversity Framework, which includes leveraging eDNA as a strategy to obtain comprehensive insights into species presence and distribution.

Biodiversity monitoring technologies will enable businesses to get ahead of this regulatory curve, protecting valuable billion-dollar assets and collecting the precise metrics that will enable the monitoring of key species.

Invasive Species: A Growing Threat

With companies relying heavily on the health and productivity of natural ecosystems, it is crucial to future-proof their businesses and mitigate economic risks. One significant challenge to the marine sector, which has grown rapidly in recent decades, is the prevalence of invasive species. Over 37,000 species have been introduced into biomes worldwide, with 200 new alien species recorded globally each year.

To date, more than 11 percent of all alien species are considered a threat to biodiversity and ecosystems, and this number is projected to increase by 36 percent by 2050 compared to 2005 levels. With a global economic

cost annually exceeding \$423 billion, invasive species pose a serious threat to marine companies, including ports, shipping, offshore wind, utilities and energy sectors.

For instance, since its arrival in the Gulf of Mexico nearly a decade ago, Japanese wireweed has threatened the long-term health of valuable seagrass meadows and native species while interfering with vital marine infrastructure, including water and power supplies. In situations where invasive species can significantly impact business operations, it is in a company's best interest to identify and address them as early as possible. eDNA technology offers a crucial advantage in this regard, as it can detect invasive species at much lower population levels than conventional surveys, allowing companies to tackle and halt their introduction into native ecosystems sooner. This provides companies with the assurance that potential problems beneath the waves are identified and managed proactively.

NatureMetrics' work with Norfolk Rivers Trust is an example of how eDNA tech enables species monitoring. eDNA surveys were used to monitor native, white-clawed crayfish and invasive signal crayfish in U.K. rivers. These species are difficult to track via conventional methods. With eDNA tech, the team was able to protect remnant populations of the endangered native species and address areas for potential reintroduction while identifying sites threatened by the invasive crayfish.

Future-Proofing Marine Businesses

Early adoption of biodiversity monitoring tools will enable companies to map the ecosystems in which they operate and future-proof their marine projects and investments from regulatory frameworks, public scrutiny, and harmful invasive species. eDNA technologies will enable marine sector companies to monitor and analyze their biodiversity impact, empowering nature-positive decision making and mitigating the economic and reputational risks associated with their interactions with nature.

By utilizing eDNA technology, businesses will be able to simplify and reduce the cost of biodiversity monitoring and obtain a more complete picture of the ecosystems on which they depend. With 70 percent more species detection and increased accuracy, this methodology will increase alien species preparedness through early identification to protect marine economic activities. These technologies will offer a competitive advantage to early adopters that will protect them from environmental risks, such as alien species, and enable regulatory compliance as biodiversity health monitoring becomes increasingly important. **ST**

Ben Goymer is the business development manager and offshore specialist at NatureMetrics. His experience is deeply rooted in environmental innovation, ranging from marine conservation to environmental technology. At NatureMetrics, Goymer focuses on the use of environmental DNA tech to help companies in the marine sector assess their impact on nature.

Seagrass Monitoring

USV, Hydroacoustic Collaboration to Advance Mapping in UK

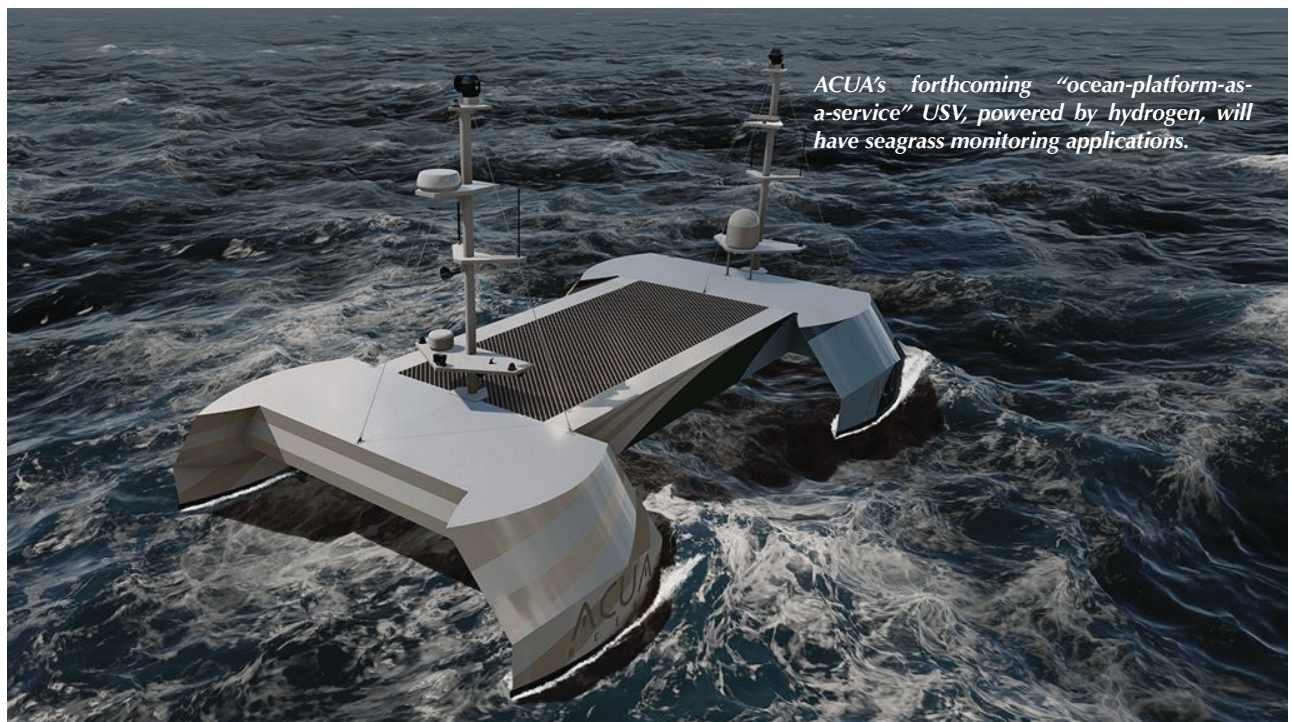
By Richard Dowdeswell • James Williams • Neil Tinmouth

Seagrasses are true plants with roots, stems and leaves, capable of photosynthesis and flowering. They form dense underwater beds, known as seagrass meadows, which can be found in shallow coastal waters around the world. These meadows play a crucial role in marine ecosystems, supporting a diverse array of marine life and providing numerous ecological benefits. Distributed across all continents, except Antarctica, seagrasses thrive in tropical and temperate regions, particularly in the Caribbean, Mediterranean, Australia, Southeast Asia and the United States.

Seagrass meadows are vital for maintaining healthy marine ecosystems, providing habitat and nursery

grounds for various marine species, including fish, invertebrates and crustaceans. They improve water quality by trapping fine sediments and particles, which reduces water turbidity and increases light penetration, benefiting other aquatic plants and organisms. Additionally, seagrasses contribute to nutrient cycling, helping maintain the balance of marine ecosystems.

These meadows are vulnerable to numerous threats jeopardizing their survival. Human activities such as coastal development, pollution and destructive fishing practices significantly degrade these habitats. Climate change also poses a severe risk, as rising sea temperatures and ocean acidification can hinder seagrass growth





and resilience. Additionally, increased sedimentation and nutrient run-off from agriculture can smother seagrass beds and lead to harmful algal blooms that block the sunlight essential for photosynthesis.

The Case for Monitoring

Seagrasses have a wide range of ecological benefits, including carbon sequestration, erosion control and economic value.

Seagrass meadows are significant carbon sinks. They capture and store large amounts of carbon dioxide from the atmosphere, helping mitigate the effects of global warming. This process, known as “blue carbon” sequestration, is crucial in the fight against climate change.

Seagrass roots also help stabilize sediments, reducing coastal erosion. This stabilization mitigates the impact of waves and storms on shorelines, thus contributing to resilience in the face of climate change and rising sea levels.

Healthy seagrass ecosystems support commercial and recreational fisheries as well, providing economic benefits to coastal communities. They are also important for tourism, as they contribute to the beauty and biodiversity of marine environments.

One-third of global seagrass meadows has vanished over the past century due to various human activities, such as nutrient runoff, trawling, coastal development, harmful anchoring and dredging. The state of seagrasses in the U.K., which has lost over 90 percent of its seagrass

beds, is an extreme example of this decline, but efforts are now underway to reverse the damage.

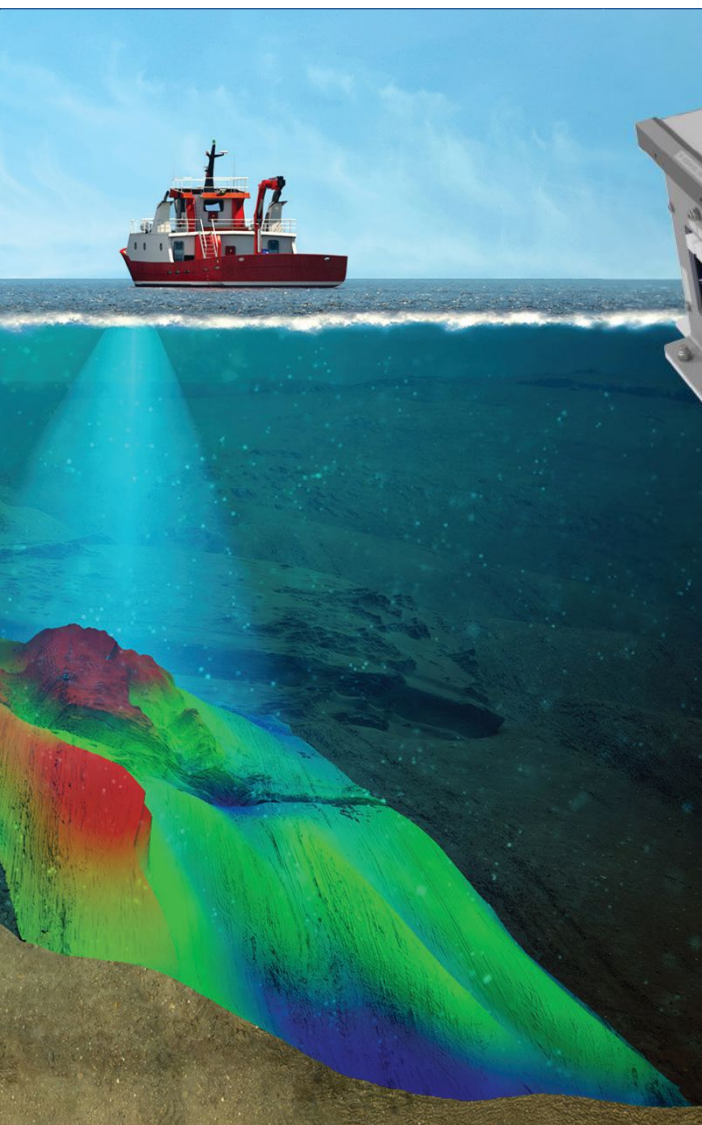
However, without a deep understanding of the process, efforts can be ineffective. Therefore, the monitoring of seagrass habitats is essential. Currently there are numerous accepted monitoring methods, including volunteers using quadrats and transects, dive surveys, satellite surveys, and single-beam acoustics.

To expand the scale of habitat mapping, remote sensing technology offers a powerful alternative to traditional methods that rely on human labor. Satellite imagery has long been used to capture extensive images of coastal areas, offering a broad overview of seagrass distribution. However, its lower resolution necessitates ground-truthing, especially in turbid and deeper waters.

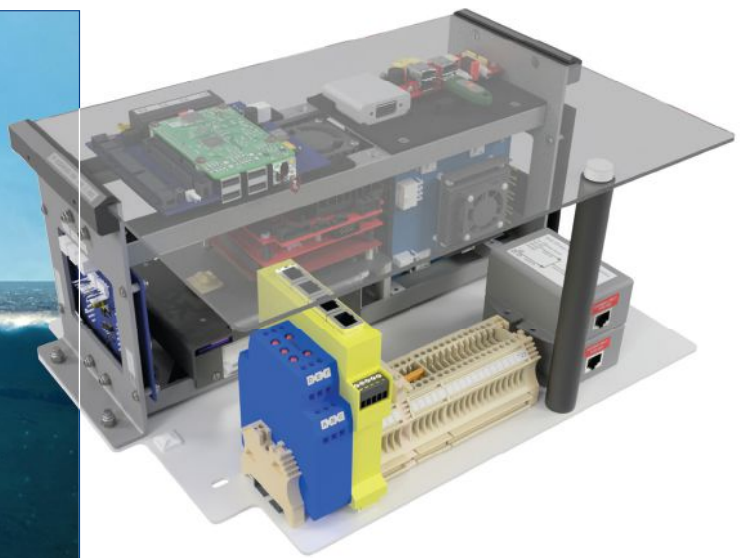
High-resolution mapping can be achieved through LiDAR technology, using drones or crewed aircraft to capture detailed images. This method, while highly accurate, is costly and less effective in the turbid waters of the U.K. due to its reliance on light and visibility, thus posing challenges for large-scale implementation.

Uncrewed Vessels Unlock Efficiency

New technologies and methodologies are developing to provide high-resolution data and insight into the density of seagrass meadows, surrounding water quality and other species’ presence. Recognizing that its seagrass habitats are close to extinction, the U.K. is investing in innovative solutions, including comprehensive monitor-



(Above) The GeoAcoustics GeoSwath 4 bathymetric sonar uses AI data processing in real time to provide an almost instant livestream of the seafloor. (Top right) The GeoSwath 4 comes in various configurations, including this USV module that allows for easy fitting and operation.



extent and density of seagrass beds and the surrounding water quality.

The project is centered in Falmouth on the U.K.'s south coast, with Penarrow Point as the primary study area. Falmouth offers an optimal setting for testing due to extensive previous and ongoing seagrass monitoring by the local Inshore Fisheries and Conservation Authority, the town council, and NGOs.

The project's main goal was to overcome the challenges of traditional seagrass mapping methods, which are often labor intensive or low resolution. By employing USVs and multibeam acoustics alongside environmental sensors and AI, the project aimed to significantly improve the efficiency and accuracy of seagrass mapping.

The successful integration of USVs, high-resolution acoustic imaging, environmental sensors and AI-driven data processing will streamline the seagrass mapping process, from data acquisition to analysis. ACUA will also use its natural capital assessment tool to measure and value the assets of the seagrass ecosystem. By assessing economic, environmental and social values, the tool will support informed decisions for the management and conservation of seagrass.

Advanced Technology in Seagrass Mapping

USS has previously incorporated the GeoSwath 4 sonar system and collaborated with GeoAcoustics on a project to provide fully automated, end-to-end bathymetric solutions. This groundwork has laid a strong foundation for the current seagrass monitoring project, especially as acoustic remote sensing approaches address the challenges of turbidity while ensuring scalability. The USS-designed and -built USVs allow for the integration of additional sensors to address any blind spots or immediate ground-truthing needs (in relation to aircraft surveying), in addition to the integration of water quality sensors.

In contrast to the less operationally efficient single-beam echosounders historically used for seagrass mapping, the project leverages the wide-swath capabilities of the GeoSwath 4 interferometric sonar, offering

ing projects, such as a new collaboration funded by the U.K. Department for Environment, Food & Rural Affairs under the program "Improving Observation Capabilities of Biodiversity in U.K. Waters," which aims to transform seagrass mapping through uncrewed vessels integrated with advanced technologies.

The project, which ran through summer 2024, was conducted by a consortium of USV and hydroacoustic technology companies comprising ACUA Ocean, GeoAcoustics Ltd. and Unmanned Survey Solutions (USS). They used USVs equipped with the GeoAcoustics' GeoSwath 4 sonar for bathymetric data acquisition, In-Situ's Aqua TROLL 800 multiparameter sonde for water quality monitoring (Sea Technology, February 2024), a camera, and AI-driven data processing to measure the habitat

significant efficiency gains in terms of coverage per ping. The system transmits beams over 40 times wider than typical single-beam systems, allowing for greater spacing between survey lines and significantly reducing survey times. The GeoSwath 4 bathymetric sonar also features an onboard AI system to automate data processing and provide real-time seagrass height estimates.

Simultaneously, the Aqua TROLL 800 will be deployed using a winch system to collect comprehensive water quality data, including temperature, depth, turbidity, dissolved oxygen, pH, chlorophyll a, phycocyanin, phycoerythrin, fluorescent dissolved organic matter, crude oil, ammonium, chloride and nitrate. These parameters provide indications of water quality, which directly affects seagrass health, including growth and presence.

The use of such advanced sensors enables comprehensive, high-resolution data collection that encompasses habitat extent, water quality and associated biodiversity. The deployment of USS's advanced USV as the monitoring platform introduces several advantages, including rapid and easy mobilization of pre-calibrated sensors, access to shallow areas from shore or a larger mother vessel, and rapid data turnaround. The USV is also a low-carbon data acquisition solution.

Achieving Insights

The advanced survey method developed by the project partners collects a diverse array of data, with each component providing unique insights into the health and

extent of seagrass meadows. But how do the data transform into actionable insights?

The process begins with developing the data for upload to story mode on Esri's ArcGIS Pro, a platform that enables stakeholders and investors to visually engage with the data to understand the findings. Next, water quality data are overlaid with seagrass survey scans from the GeoSwath system, integrating multiple data sources to create a comprehensive view of the ecosystem. Finally, simulations of alternative stable states are created, which help visualize different potential scenarios and outcomes based on the data.

Conservation and New Markets

The reach of this project extends significantly into policy and conservation efforts. Policymakers can use the timely, accurate data to support the sustainable use of coastal and marine resources, making informed decisions about coastal management and conservation priorities. By identifying areas with dense, healthy seagrass beds, conservation efforts can be more targeted, ensuring that limited resources are used effectively. Additionally, the continuous monitoring capabilities of our method enable the detection of changes in seagrass habitats and water quality over time, facilitating proactive environmental management through a risk register approach. This comprehensive approach not only aids in preserving seagrass meadows but also enhances the overall health and sustainability of marine ecosystems.

The project could set a global precedent for cost-effective and efficient marine biodiversity monitoring using advanced remote sensing and AI technologies. Adopting a "seascape" perspective moves away from isolated habitat monitoring toward a comprehensive view of the ecosystem.

The data collection methods can also support carbon and biodiversity credit markets by offering reliable and detailed information on seagrasses as carbon sinks, with accurate mapping and monitoring to enable the verification and valuation of carbon credits related to these habitats.

Additionally, high-resolution, large-scale data ensure the credibility of carbon and biodiversity offset projects, attracting investors and boosting market confidence. Detailed mapping also quantifies the ecological value and condition of various habitats, supporting the creation of biodiversity credits.

The project has potential to scale seagrass mapping to encompass entire coastal regions and offshore areas by utilizing USVs, such as those developed by USS and the forthcoming hydrogen-powered ACUA Ocean H-USV. This approach facilitates more timely consenting processes for offshore wind energy projects, enables persistent monitoring of marine protected areas, and provides more accessible data on the high seas. **ST**

Richard Dowdeswell is the chief commercial officer of GeoAcoustics.

James Williams is the CEO of Unmanned Survey Solutions.

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Submersible Optical Sensors

Instrumentation for HAB, Oil Spill and Remote Sensing Research

By Kirby Simon • Dr. Ole Mikkelsen

Optical instrumentation generally provides high-resolution and, in many instances, real-time data that can significantly improve environmental monitoring efforts. For example, harmful algal blooms (HABs) and oil spills in freshwater and marine environments can be monitored with in-situ sensors to understand spatio-temporal dynamics of these events and enable early intervention to mitigate negative impacts on human and ecosystem health. Additionally, submersible optical instrumentation enhances satellite remote sensing capabilities for monitoring key oceanic parameters by augmenting and assisting in the interpretation of data gathered from satellite instrumentation. The in-situ measurement of properties of the water, such as absorption and scattering, and constituents in the water, such as phytoplankton and particulate matter, is critical to our understanding of light propagation in the ocean, its effects on marine life, and how satellites can be used to detect and monitor these in-water constituents remotely.

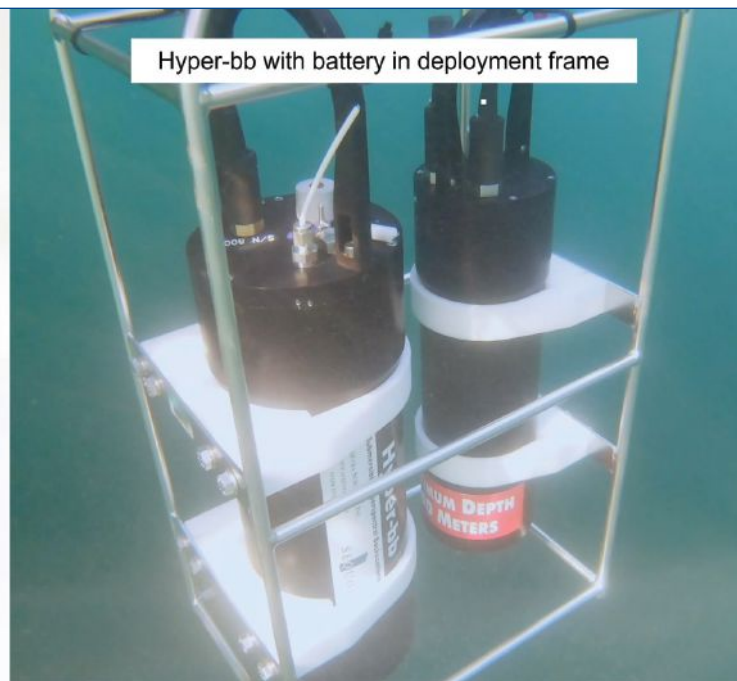
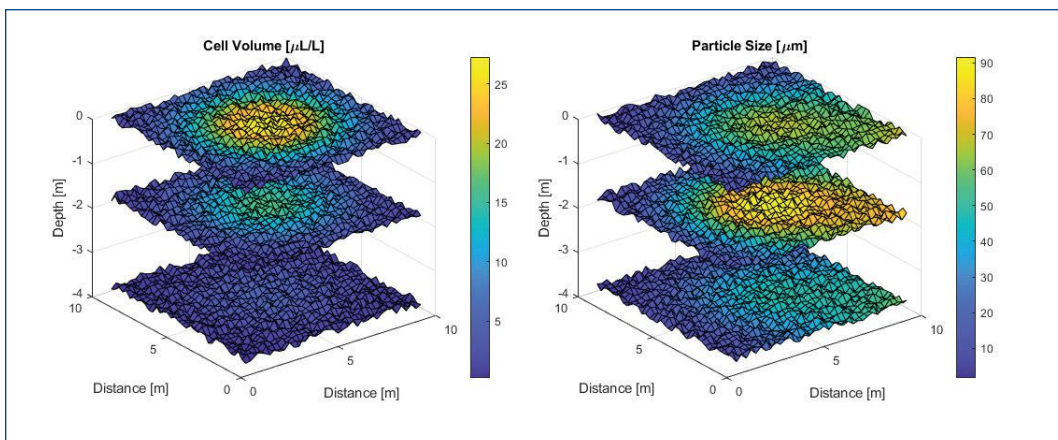
Sequoia Scientific Inc., based in Bellevue, Washington, has been a leading manufacturer of submersible optical sensing instrumentation for studying particles and optical properties in marine and freshwater environments for almost 30 years. Sequoia's instruments measure a broad range of in-water properties, from particle size and concentration to transmission, backscattering and absorption, providing necessary measurements to support environmental monitoring efforts and remote sensing missions. Specifically, Sequoia's optical sensors have been used to study HABs and oil spills in situ, as well as measure inherent optical properties necessary to support the monitoring of phytoplankton and other in-water constituents from satellites.

HAB Monitoring

Monitoring and understanding HAB dynamics are crucial for several reasons. First, HABs can produce toxins that can cause large-scale marine mortality events and



Sequoia's LISST-HAB and LISST-Black both comprise a LISST-200X submersible particle size analyzer with three integrated Turner Designs fluorometers.



(Top) Simulated depth-profiled LISST-HAB measurements correlating cell volume (left) and particle size (right) to investigate cell type and dynamics in surface waters. (Bottom) Sequoia's Hyper-a and Hyper-bb are self-contained, programmable, autonomous instruments for measuring in-water hyperspectral absorption and backscattering, respectively.

contaminate seafood, posing a significant risk to public health. Second, HABs can disrupt aquatic ecosystems by depleting the water column of oxygen, leading to dead zones where most marine life cannot survive, with cascading effects on the food chain and biodiversity. Industries such as fishing and tourism, and subsequently human health and wellbeing, can therefore be negatively impacted by these blooms.

Monitoring for these blooms and bloom indicators enables early detection and mitigation, informing management strategies to control blooms and minimize their impacts. Employing instrumentation or distributed sensor networks for in-situ monitoring is thus useful for pro-

tecting public health, preserving aquatic ecosystems and preventing economic losses.

Sequoia's LISST-HAB is a standalone system designed for detecting and monitoring HABs. It combines a standard LISST-200X submersible particle sizer with a set of Turner Designs fluorometers measuring phycocyanin, phycoerythrin and chlorophyll, which are all pigments commonly associated with HABs. The fluorometers are powered and logged by the LISST-200X, thereby integrating the data from all fluorometers into the standard LISST-200X data stream.

The fluorescence measurements from the LISST-HAB can help identify and quantify harmful algal pigments. By measuring the particle size distribution, the LISST-HAB aids in understanding bloom dynamics, for example growth rates and cell volume. Deployed on profiling packages or towed vehicles, the LISST-HAB provides real-time data, enabling real-time bloom tracking and timely responses/interventions to HAB events. Subsequent data processing can yield, for example, detailed 3D mapping of an entire bloom or provide cell count of relevant algae species.

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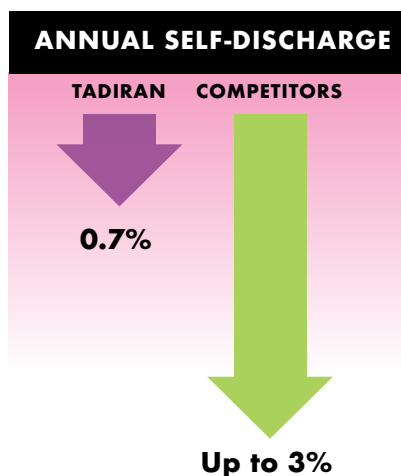


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Oil Spill Monitoring

The U.S. Environmental Protection Agency's (EPA) National Oil and Hazardous Substances Pollution Contingency Plan (NCP) outlines requirements for oil spill monitoring in the United States. These requirements have been put in place because a full assessment of an oil spill, including the location, spread, type and condition of the oil, and the effectiveness of the dispersant, is vital when making decisions about dispersant use. In particular, the NCP requires monitoring of in-situ oil droplet size distribution for droplet sizes from 2.5 to 2,000 micrometers, but predominantly in sizes up to 100 micrometers. The droplet size distribution may serve as an indicator of the effectiveness of dispersant operations. Effective dispersants yield a greater proportion of small droplets than large droplets. For subsea spills, larger droplets rise to the surface faster and can coalesce—forming slicks or sheens. Smaller droplets, however, remain suspended longer in the water column and are subject to water fate and transport processes, such as biodegradation, dissolution and aggregation.

The data collected from monitoring informs operational decisions during a response by enabling the on-scene coordinator and other decision makers to consider the impacts of dispersant application in real time. Using data to target the use of dispersants during an oil spill response reduces the risks that oil discharges and response technologies pose to the environment. This is crucial in minimizing the environmental impact of oil spills.

The NCP also promotes coordination among responders and contingency plans, facilitating research to improve response activities. This ensures a comprehensive and effective response to oil spills.

Sequoia's LISST instruments have a long track record in oil spill monitoring and research. Approximately 7 percent of all scientific papers using LISST data are oil spill and/or dispersant-use related. For instance, during the response effort in the aftermath of the 2010 Deepwater Horizon accident, the EPA mandated LISST use for droplet monitoring a few days after the accident.

The LISST-Black can play a significant role in oil spill monitoring. Like the LISST-HAB, and only differing by the type of integrated fluorometers, the LISST-Black is a standalone instrument system for use on profiling packages, towed and remote vehicle applications; for deployment during and after an oil spill event; or for laboratory studies. The system continuously measures particle size distribution and concentration, along with the fluorescence of refined fuels, crude oil and chlorophyll. This allows for a comprehensive, real-time picture of the spill dynamics and aids in the effective management of dispersant use, thereby aligning with the EPA's guidelines. For larger droplet sizes, beyond 500 micrometers and up to 2,000 micrometers, other Sequoia submersible particle size analyzers can be effective; the LISST-Holo2, for example, provides data on the size and shape of larger droplets using digital inline holography. Multiple oil spill response organizations in the U.S. and abroad have the LISST-Black and LISST-Holo2 in their standard instrumentation portfolio to comply with the NCP.

Remote Sensing and Water Optical Properties

The use of satellites to study the Earth's oceans has revolutionized oceanography research. Since the 1970s, satellites have enabled synoptic monitoring of the world's oceans, providing data on a global scale previously unattainable. This has been crucial for understanding both large-scale oceanographic phenomena, such as El Niño and La Niña, and smaller scale phenomena, such as mesoscale ocean eddies and coastal currents.

The advent of high-resolution, hyperspectral satellite imagery has enabled observation and measurement of coastal changes, sea surface temperatures and ocean color with unprecedented detail. Ocean color is particularly important, as it can be tied to the in-situ optical properties of water. The optical properties, in turn, are determined by suspended particle size and concentration, phytoplankton pigment concentration and types, dissolved organic matter concentration and types, and many other constituents. In shallow water, the optical properties are also heavily influenced by the seabed bottom type and composition. For example, the water optical properties over a shallow coral reef differ from the optical properties encountered over a shallow sandy bottom. Thus, a thorough understanding of how the in-water optical properties change with changes in seawater constituents is crucial for our ability to use remote sensing ocean color measurements for large-scale determination of these in-water constituents. In-situ measurements of in-water optical properties and constituents are therefore necessary to support and validate concurrent remote sensing measurements.

Since light in water can only be scattered or absorbed, the focus has been on measurements that allow determination of the absorption or scattering characteristics of in-water constituents. For example, Sequoia's Hyper-bb instrument is used to investigate in-situ hyperspectral backscatter in the oceans. Backscatter is often used as a proxy for the standing stock of particulate carbon, including living organisms. The Hyper-bb has been used to improve calibrations and validations of regional remote sensing retrievals of phytoplankton carbon, furthering our understanding of how spectral backscattering coefficients change with phytoplankton community composition. In a specific use case, the Hyper-bb has been deployed with other sensors to measure the optical signal of ash and ash mixed with phytoplankton with the goal of ultimately using satellites to study the impact of volcanic ash on phytoplankton growth on a global scale.

Sequoia's Hyper-a instrument provides hyperspectral measurements of the in-situ absorption characteristics of water. Absorption is heavily influenced by the concentration and composition of in-water constituents, such as phytoplankton, which all absorb light differently and impact the total absorption spectrum of a bulk water sample. For example, all phytoplankton contains pigments, but the types and concentrations of pigments vary between different phytoplankton communities. Since the absorption characteristics for individual pigments have been known for some time, it is therefore possible in principle to distinguish between pigment types, and sub-

sequently the associated phytoplankton groups, based on bulk absorption characteristics.

Next-generation satellites, including NASA's recently launched PACE (Plankton, Aerosol, Cloud, ocean Ecosystem) and planned future GLIMR (Geosynchronous Littoral Imaging and Monitoring Radiometer) and SBG (Surface Biology and Geology) missions stand to revolutionize Earth observation capabilities in the coming years by moving from multispectral to hyperspectral sensing to monitor ocean color. Thus, it is critical to expand the use of in-situ hyperspectral sensors for measuring optical properties, such as absorption and scattering, to ground-truth satellite measurements and enable the determination of type, concentration, and distribution of particles, such as phytoplankton, from space. Coupling in-situ data to remote measurements from hyperspectral satellites enhances our ability to monitor, understand and model ocean ecosystems.

In summary, Sequoia's instruments play critical roles in marine research, from assessing water quality to monitoring environmental changes. Their applications span remote sensing, oil spill response and harmful algae detection, contributing valuable insights to oceanographers and scientists worldwide.

Acknowledgments

The Hyper-a and Hyper-bb were developed through SBIR grants from NASA under award numbers 80NSS-C20C0472, 80NSSC21C0491, NNX16CG52P and NNX-

17CG12C. The views and opinions that the authors express here do not necessarily state or reflect those of the U.S. government.

References

For a list of references, contact Kirby Simon at: kirby.simon@sequoiasci.com. **ST**

Kirby Simon is the science and technology lead at Sequoia Scientific Inc. Prior to joining Sequoia, he helped develop more than a dozen optical sensing technologies for planetary science, ocean science and environmental monitoring. At Sequoia, he specializes in the R&D and deployment of optical sensors in ocean environments.



Dr. Ole Mikkelsen is the president and CEO of Sequoia Scientific Inc. He has been active in oceanography as a scientist and/or working for ocean science instrumentation and equipment manufacturers since 2001.



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Powering Argo Floats

Hybrid Lithium Battery Packs Enable Profiling Up to 2,000-m Depth

By Michael McClune • Dr. Lee Gordon



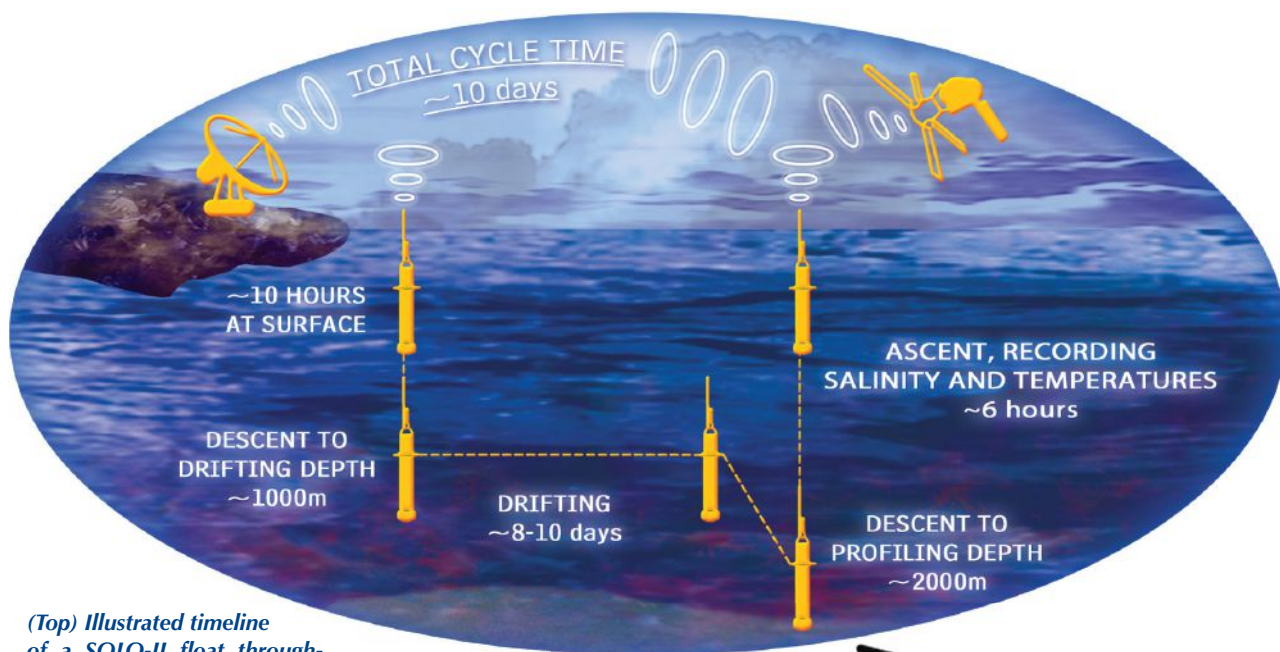
Float being deployed on the ocean's surface prior to beginning a dive cycle. (Credit: Argo Program)

Choosing the right battery is essential to maintain oceanographic instruments deployed at remote sites and harsh environments. The Argo SOLO-II autonomous float profiler is a prime example.

Based on the pioneering research of Russ Davis (now deceased) of the Scripps Institution of Oceanography, battery-powered SOLO-II floats are in the field worldwide as part of the Argo program to assess global climate change across the upper ocean. Argo floats measure temperature, salinity and pressure to depths of 2,000 m,

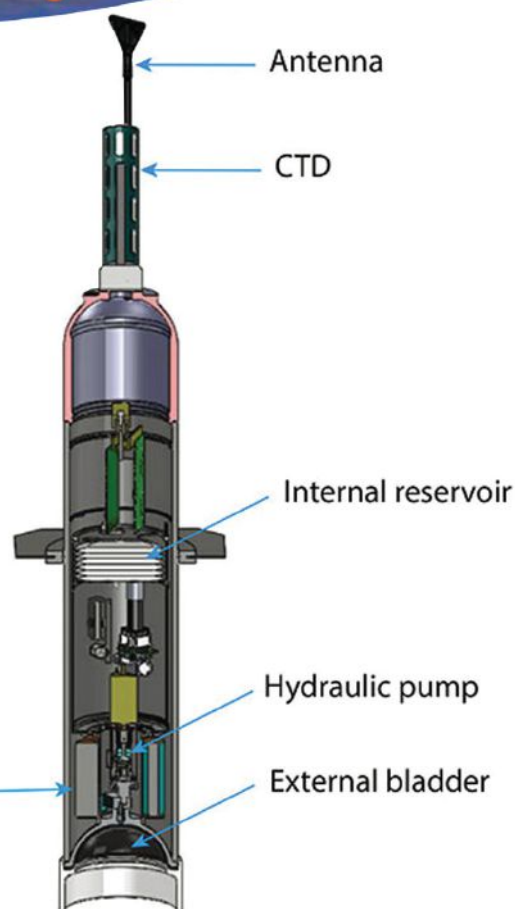
and they telemeter real-time data. In addition, there are deep Argo floats that profile at depths beyond 6,000 m of water.

The SOLO-II was first deployed in 2010 and is considered the gold standard; it outperforms nearly half a dozen similarly designed Argo floats in use by an international consortium of roughly 30 countries. The Argo Steering Team's original vision was to keep 3,000 floats operational worldwide, roughly one float for every 3° of latitude and longitude. The initial design goal was for



(Top) Illustrated timeline of a SOLO-II float throughout a dive cycle. (Credit: Argo Program)

(Bottom) Schematic of a SOLO-II float and battery pack. (Credit: Argo Program)



Argo floats and their batteries last five years; therefore, 800 new floats had to be deployed every year to sustain this network of 3,000 floats.

Operation Cycle

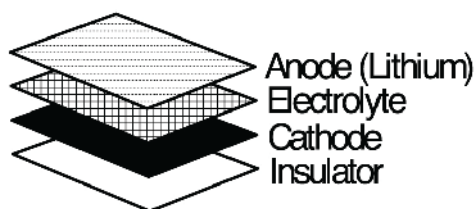
SOLO-II floats spend most of their time drifting at a depth of 1,000 m, where they produce an accurate map of currents. Each float wakes up every 10th day and opens a valve to decrease its buoyancy. This extra weight carries the float down to a depth of 2,000 m, where its ballast pump starts pumping oil from an internal reservoir into an external bladder, which increases the float's volume to make it buoyant. This begins its ascent to the surface.

The pump works hardest when it starts up because it is pumping against 200 atmospheres of pressure. Once the float begins its ascent, the pump runs when necessary to keep the float rising at a controlled rate while it samples temperature, salinity and pressure in a vertical column from 2,000 m to the sea surface. At the surface, the float uses additional battery power to telemeter collected data via satellite, then it dives back to 1,000-m depth to begin another 10-day cycle.

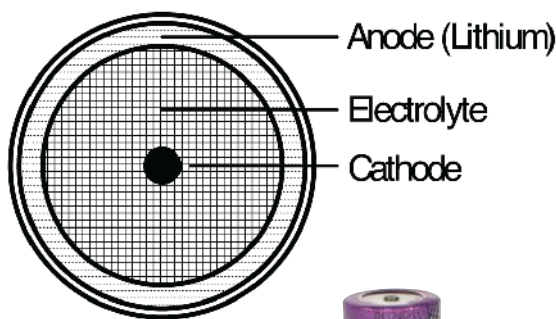
The SOLO-II ballast pump was originally used in Spray underwater gliders, where it worked reliably in conjunction with its spiral-wound lithium sulphuryl chloride (LiSO_2Cl_2) battery packs. Spiral-wound packs are designed to supply the high currents required to run the glider's pumps. The same batteries were also used in the original SOLO floats for more than a decade.

Following the success of Spray gliders, the same pump and batteries were designed into the SOLO-II floats.

However, the pump motors in the earlier generation floats demanded less power than the motors used in the SOLO-II floats. Although everything worked well at first, problems appeared as deployments progressed. Because SOLO-II floats dive to twice the depth of Spray gliders, their pumps require twice the power to work against double the pressure. The batteries in the SOLO-II rest for 10 days between dives, whereas the batteries in the Spray gliders powered dives several times every day. After some



Spiral Wound
Primary Cell



Bobbin
Primary Cell



(Top) There are two types of LiSO_2Cl_2 cells: bobbin-type and spiral-wound construction. Spiral-wound cells feature a greater surface area for reactivity to occur, enabling higher current, with the trade-offs being lower energy density and a higher self-discharge rate. Bobbin-type LiSO_2Cl_2 cells are better suited for low-current applications, featuring higher energy density, higher capacity, a wider temperature range (-80 to $+125^\circ\text{C}$), and a far lower self-discharge rate for longer battery life. (Credit: Tadiran)
(Bottom) PulsedPlus hybrid battery packs combine a bobbin-type LiSO_2Cl_2 cell for low-rate current during standby mode, with a patented HLC that delivers high pulses during active mode. (Credit: Tadiran)

time in the ocean, the spiral-wound batteries began to passivate to the point where they could not generate enough power to run the pump in the SOLO-II.

Passivation Process

Passivation comprises a layer of LiCl that forms on the surface of the lithium metal inside the cells, and it serves to minimize the battery's self-discharge rate. The spiral-wound cells first used in SOLO-II floats encountered problems because the passivation layer grew too

thick during the float's 10-day inactive periods for the batteries to generate the pulsed energy required to power the pump.

Drawing current from a passivated battery dissipates the passivation layer, so Scripps' engineers prepared the batteries in advance of the dives, implementing various strategies to draw moderate currents through the batteries before initiating 2,000-m dives, which enabled the floats to continue their work. While successful, the effort was time consuming and personally draining, given that Scripps has hundreds of floats in the water.

In search of a long-term solution, Scripps and Doppler Ltd. began testing Tadiran PulsedPlus battery packs as replacements for the spiral-wound packs. The PulsedPlus packs use bobbin-type lithium sulphuryl chloride cells that store significant amounts of energy but cannot normally provide the high-rate current required by the SOLO-II's pump, so they are combined with Tadiran's patented Hybrid Layer Capacitor (HLC) cells to create a hybrid solution. The HLCs store far less energy than the primary cells but deliver plenty of power to run the pump through a dive cycle. The primary cells then have more than enough time to recharge the HLCs during the inactive periods between dives. This hybrid approach is highly energy efficient, with nearly all of the primary cells' stored energy being used to power the float, with very little waste.

Field Testing

After a series of laboratory tests, Scripps deployed two SOLO-II floats for ocean tests offshore San Diego. One version of the float was equipped with three Tadiran battery packs to replace the standard complement of spiral-wound packs, and another was given only two battery packs. Each PulsesPlus pack held eight primary D cells and 4 AA HLC cells. The floats were run through a variety of different test sequences intended to represent the range of float operation, and both floats performed well, with none of the issues associated with the spiral-wound batteries.

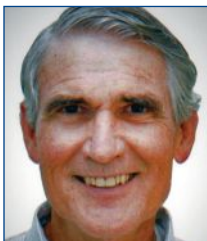
Scripps' initial intent was to transition progressively from spiral-wound cells to the PulsesPlus packs. However, these packs performed so well that project manager Dean Roemmich decided to complete the transition in the second year. The packs not only eliminated the passivation problem, but Scripps also found that their deployments would last up to 12 years, more than twice as long as originally expected.

Conclusion

PulsesPlus battery packs were designed to serve applications that require intermittent, or pulsed, power, with the SOLO-II floats providing a prime example. PulsesPlus batteries, in use throughout the oceanographic industry, also offer an extended battery life, able to power certain applications for up to 40 years. Applications include: Cospas-Sarsat distress beacons; emergency locator transmitters; animal location and health monitoring; cell, radio and satellite communications; seismic devices; sonobuoys; transponders; and data loggers.

Russ Davis remained actively involved with Scripps' Argo program in his later years. When asked about the possibility of accelerating the dive cycle from 10 to five days, Davis felt that the Argo program would be better served by deploying more floats to increase the network density instead of focusing on decreasing the dive cycle time. Doubling the deployment duration via SOLO-II floats powered by PulsesPlus batteries helps to achieve Davis's vision. **ST**

Michael McClune worked 38 years at Scripps Institution of Oceanography, designing scientific devices and software.



Dr. Lee Gordon is a physical oceanographer who has spent most of his career working with acoustic Doppler current profilers. He has been supplying lithium battery packs for oceanographic instruments over the past two decades.



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Monitoring Corrosion Protection

Non-Contact Measuring of Subsea Electric Field Gradients

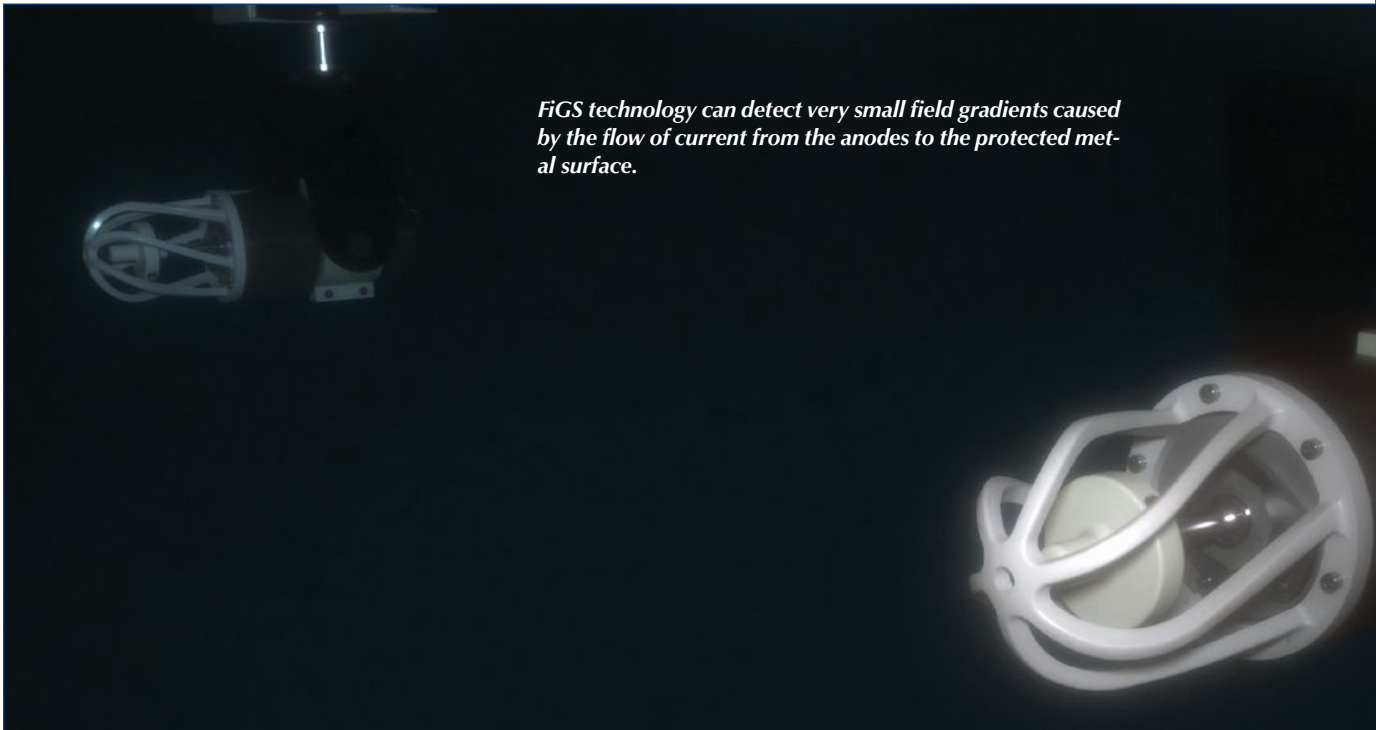
By Svernn Magne Wigen

Corrosion is a significant challenge for subsea structures, arising due to the electrochemical reactions between metals and seawater. This process leads to the gradual degradation of materials, posing substantial risks to the integrity of underwater installations, such as pipelines, platforms, and other infrastructure essential to the oil and gas industry. The primary catalyst for corrosion in subsea environments is the presence of oxygen and salt, which facilitates the electrochemical reactions that degrade metals.

The risks associated with corrosion are extensive and severe. Structural damage can compromise the safety and functionality of subsea installations, leading to leaks,

spills, and catastrophic failures. One notable example of such an incident is the Montara oil spill in 2009, where a blowout caused by corrosion and other factors led to a significant oil spill in the Timor Sea. Another instance is the Deepwater Horizon disaster in 2010, where corrosion of the blowout preventer contributed to the failure that resulted in one of the worst environmental disasters in history.

These incidents highlight the critical need for effective corrosion management and monitoring systems to prevent such occurrences. The financial and environmental costs of corrosion-related failures are staggering, including cleanup costs, legal liabilities and the long-term envi-



FiGS technology can detect very small field gradients caused by the flow of current from the anodes to the protected metal surface.



Two FiGS sensors mounted on an ROV for pipeline inspection.

ronmental impact on marine ecosystems. As the offshore industry continues to explore deeper and more challenging environments, the importance of addressing pipeline and structural corrosion effectively becomes even more essential.

The Necessity of Cathodic Protection

Cathodic protection (CP) is a vital technique used to mitigate the effects of corrosion on subsea structures. CP works by converting the entire metal surface of a structure into a cathode of an electrochemical cell. This is typically achieved by attaching sacrificial anodes made of more reactive metals, such as zinc, aluminum or magnesium, which corrode instead of the structure's and pipeline's exposed surfaces. Alternatively, impressed current systems use an external power source to provide a protective current from inert anodes.

Despite its effectiveness, CP systems degrade over time. Sacrificial anodes gradually deplete and lose their effectiveness, while impressed current systems can suffer from electrical failures or damage to components. Regular monitoring of CP systems is essential to ensure continued protection. Monitoring involves assessing the potential difference between the structure and a reference electrode to determine the effectiveness of the CP system.

Traditional monitoring or inspection methods include the use of divers and ROVs

equipped with CP probes that must make contact with the structure being monitored in order to provide a reading. Divers perform manual inspections, which are time-consuming, expensive and carry significant safety risks. ROVs offer a safer alternative but can be limited by visibility and accessibility issues as they have to maneuver close enough to the target to make contact with it.

The challenges of monitoring CP systems highlight the need for advanced solutions that can provide more accurate, efficient, and cost-effective monitoring. Technologies such as the FiGS (Field Gradient Sensor) system represent a significant advancement in this field, offering improved data accuracy and operational efficiency.

Non-Contact CP Monitoring

The FiGS system, developed by FORCE Technology Norway, represents a groundbreaking advancement in the field of cathodic protection monitoring for subsea structures. Unlike traditional CP monitoring methods that often rely on direct contact techniques, FiGS operates through a non-contact approach, measuring the electric field gradients in the seawater around the protected structure. This innovative method offers a significant leap forward in accuracy, efficiency and safety.

At the core of FiGS technology is its ability to detect very small field gradients caused by the flow of current from the anodes to the protected metal surface. The system employs high-sensitivity sensors capable of detecting these variations with exceptional precision. By analyzing the electric field gradients via computer modeling, FiGS provides a detailed map of the CP system's performance,

highlighting areas of adequate protection and identifying potential issues, such as coating damages or depleted anodes.

FiGS overcomes the shortcomings of traditional CP measuring methods, significantly reducing safety hazards and logistical complexities. Furthermore, FiGS sensors offer a higher sensitivity and accuracy compared to conventional CP probes. This enhanced sensitivity is particularly beneficial for identifying early signs of coating damage, anode depletion and other potential issues that might otherwise not be detected. The system's ability to provide a more detailed and comprehensive assessment of the CP performance ensures that problems can be addressed proactively, timely preventing minor issues from escalating into major failures.

Enabling Faster CP Surveys

The operational efficiency of FiGS is another key advantage. Traditional inspections can be time-consuming and costly, often requiring extensive manual labor and significant downtime. In contrast, FiGS surveys can cover large areas quickly and efficiently, reducing the overall operational time and associated costs. The system's capability to function effectively at greater distances from the structure also minimizes the risk of equipment damage and ensures continuous data collection, even in adverse conditions.

A FiGS pipeline survey can be performed with ROVs and AUVs traveling at speeds of up to 6 to 8 km/h without compromising the quality of the information gathered. This rapid data collection surpasses that of any other advanced CP inspection tools available. Additionally, FiGS can operate effectively at greater distances above the pipeline, capturing valuable data even when positioned higher above the structure.

Importantly, FiGS is versatile enough to be used on buried, trenched or rock-dumped pipelines, providing the same level of detailed information as it does for exposed pipelines. It seamlessly integrates with active pipe trackers, such as the Teledyne TSS 440, as the tracker's signals do not interfere with FiGS sensor readings. This integration eliminates the need for a preliminary survey with the pipe tracker, significantly reducing offshore operational time and costs, particularly those associated with vessel charter.

Accurate and Extensive Reports

A FiGS report provides comprehensive insights into the condition of a pipeline or subsea structure's CP systems. It typically includes a potential profile for pipelines and a potential distribution for three-dimensional structures, pinpointing areas of under-protection or hotspots. The report also details the anode current output, with remaining life for pipeline and other structure anodes, and addresses possible current drain issues, offering a clear picture of the CP system's effectiveness.

Additionally, it details the effective steel current density, accounting for any coating breakdown on pipelines and other structures. The current drain, which is the current supplied by anodes on pipelines or other structures

to adjacent infrastructure, such as wells, is also evaluated. Moreover, the report includes an assessment of the CP system's life expectancy, indicating the remaining life of sacrificial anodes, and estimates the time until protection is lost. Finally, it provides recommendations for the timing of the next inspection based on the current condition of the CP system.

In terms of cost savings, FiGS surveys have been demonstrated to significantly reduce the need for extensive manual inspections and potential repairs. The use of FiGS can lead to cost reductions of up to 50 percent on retrofit systems. For example, a FiGS survey on a buried pipeline in the North Sea after nearly 40 years in service revealed anode depletion was significantly less than anticipated, allowing for a more targeted and cost-effective retrofit plan, saving millions of dollars in unnecessary anode replacements.

In another notable case, FiGS was used to inspect 17 pipelines, 20 mid-size jackets and six wellheads. The use of FiGS resulted in the vessel and ROV costs dropping from \$1,200,000 to \$560,000, and inspection costs decreased from \$450,000 to \$100,000. This case highlights how FiGS not only provides comprehensive CP status and life expectancy data but also slashes the cost of CP monitoring data acquisition. A similar case using a fast ROV resulted in \$700,000 in savings.

Enabling Sustainability, Efficiency

FiGS represents a significant advancement in the field of CP monitoring, addressing many of the challenges associated with traditional methods. Its ability to provide accurate data on the condition of CP systems with greater operational range offers substantial benefits in terms of cost savings, efficiency and safety.

As the offshore industry continues to face increasing environmental and operational challenges, the adoption of advanced monitoring solutions such as FiGS is essential. By leveraging the latest technologies and approaches, operators can effectively mitigate the risks associated with corrosion, extend the life span of their assets, and prevent costly and environmentally damaging incidents.

The real-world applications of FiGS demonstrate its effectiveness and the significant value it brings to subsea operations. As the industry moves toward more intelligent and data-driven maintenance strategies, FiGS is poised to play a pivotal role in ensuring the safety and reliability of subsea infrastructure, ultimately contributing to a more sustainable and efficient offshore industry. **ST**

Svenn Magne Wigen is the business director and sales manager at FORCE Technology Norway AS.



marinerenewables

OTEC Construction Milestone

Currently under construction at Hidramar Shipyard in Gran Canaria, Spain, a prototype designed to advance ocean thermal energy conversion (OTEC) in storm-prone areas has reached the 50 percent completion milestone.

Fabrication began in March, and once completed, the cylindrical hull, along with a cold-water riser pipe and gimbal connection point, will be assembled in the Atlantic Ocean for testing.

This structure is being developed by PLOTEC (the Oceanic Platform of the Canary Islands), a pan-European consortium funded by the EU that includes seven companies.

The project aims to advance the renewable energy transition for small island developing states (SIDS) that are vulnerable to severe weather conditions. This will be achieved by enhancing OTEC technology

with an offshore platform specifically designed to withstand intense tropical storms, hurricanes and cyclones. The PLOTEC 1:5 scaled prototype will be installed for testing at PLOCAN, approximately 3 km off the coast of Spain.

Investment Potential of Solar, Offshore Wind Supply Chains

The investment potential for solar and offshore wind power project supply chains exceeds \$1.1 trillion through 2050, with the capacity to generate 873 GW of clean energy, according to a new report from the Institute for Energy Economics and Financial Analysis (IEEFA).

The report focuses on seven Asian markets: Japan, South Korea, Malaysia, Taiwan, Vietnam, Philippines and Indonesia. IEEFA calculates that, up to 2050, solar PV plans aim to achieve 634 GW of capacity, requiring an investment of

\$394 billion, with \$346 billion of that amount potentially to be spent on local supply chains. Offshore wind represents a \$621 billion opportunity to deliver 239 GW of capacity, with \$425 billion expected to be localized.

Additionally, there is an opportunity in the maritime sector worth \$72 billion to \$97 billion to build offshore wind installation and service vessels, with almost all this investment expected to be sourced regionally.

A key message for policymakers and industrialists is that it is unnecessary to make solar PV modules or wind turbines in order to realize huge domestic manufacturing and investment benefits.

According to the report, non-panel and non-turbine spending will account for at least 75 percent of total investment through 2050, representing a \$770 billion opportunity for domestic industries over the next 25 years. There are materials, components, infrastructure, logis-

Vector Offshore NDB System

Oil platform, support vessel and wind farm applications

Nautel's field-proven Vector Series VR125 non-directional radio beacon (NDB) transmitter offers solid-state reliability, 24/7 customer support and 3-year warranty.

Highlights include:

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- Single or dual (main/standby with automatic changeover) configurations.
- Synthesized exciter uses advanced DDS technology to produce highly stable RF drive at the desired operating frequency.
- Extensive automatic fault monitoring, with 256 event log, for faster troubleshooting.

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nautelnav.com/offshoreNDB



tics, and services that can provide significant value to the domestic economy over sustained periods and could be marketed regionally and beyond.

Offshore wind resources in Asia are abundant, high-quality and predictable. The region's traditional maritime economies possess inherent advantages in shipbuilding, steel fabrication, marine maintenance and offshore services, making them well-suited for large-scale

offshore wind projects. The wind energy capacity available to nearly every country in Asia-Pacific is greater than the current total installed capacity from all sources of generation. Wind farms are becoming competitive enough to undercut imported natural gas and coal, even in markets where those prices are subsidized and in the absence of carbon pricing.

Shipbuilding for offshore wind presents a standalone opportunity

worth up to \$97 billion, with most of that investment needed in the near term. Currently, there are only a limited number of niche shipyards constructing these vessels, mainly in Norway and China. There is a particular need for specialized wind turbine installation vessels, as only a few can install the largest, next-generation turbines.

The combined offshore wind farm and specialty vessel market represents an investment opportunity of around \$878 billion through 2050.

Offshore Floating Solar Pilot

With the support of RWE, a German multinational energy company, the Dutch-Norwegian company SolarDuck has installed its offshore floating solar (OFPV) Merganser project. The pilot aims to test and demonstrate the structural, mooring, and electrical designs and acquire knowledge about manufacturing, assembly, offshore installation, and maintenance methodologies required for large-scale commercial deployment of OFPV.

The floating platforms were successfully connected to the mooring system at 20-m water depth.

Merganser has a capacity of 0.5 megawatt peak and is located in the Dutch North Sea, approximately 12 km off the coast of Scheveningen. The scalable concept comprises six interconnected platforms that can withstand extreme offshore conditions.

Wind-Assist Propulsion Retrofit For Combo Carrier Vessel

BHP, Pan Pacific Copper (PPC) and Norsepower have completed the retrofit installation of a Norsepower Rotor Sail (NPRS) on board the MV *Koryu*, a combination carrier operated by Nippon Marine that will carry copper concentrates from Chile to Japan and sulphuric acid from Japan to Chile. The rotor sail, standing 35 m tall with a diameter of 5 m, has a tilting foundation that allows it to be lowered down to facilitate cargo loading and discharge operations at ports. NPRS is a modernized version of the Flettner rotor, based on the Magnus effect. **ST**



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Updated Guidance on Carbon Storage

DNV has supported the European Commission's update of the four non-binding guidance documents (GDs) on geological carbon storage under the Carbon Capture and Storage (CCS) Directive. This update aims to streamline permitting procedures and support sustainable CO₂ storage solutions in the European Economic Area.

Key updates focus on novel CO₂ storage technologies in mafic/basalt rocks and depleted hydrocarbon reservoirs, CCS value chain aspects, corrosion and safety issues, and the regulatory transition from hydrocarbon production to CO₂ storage. The updated GDs also offer a more balanced, risk-based approach to establishing financial provisions for CO₂ storage permits. Interpretations and methodologies, such as the definition of what constitutes CO₂ leakage, are also clarified.

The EU Net Zero Industry Act recently came into force and identifies CCS as a strategic net-zero technology, setting a target of 50 million tonnes of annual CO₂ injection capacity by 2030 and mandating contributions from oil and gas companies.

Fulkrum Moves to Larger Office

Fulkrum, a provider of inspection, expediting, auditing and technical staffing services for the upstream, midstream, and downstream oil and gas and renewables markets, has relocated its Asia-Pacific headquarters to a new, larger office in Kuala Lumpur, Malaysia. This is in response to the company's rapid expansion and significant personnel growth over the past few years, driven by a series of new clients and contract awards in the region.

Silverstream Launches New Hub

Maritime clean technology company Silverstream Technologies has launched its new global operations center in Southampton, U.K. The new hub will enhance Silverstream's operational capabilities and support the existing fleet. It is equipped for further R&D on Silverstream's Control and Monitoring System (CMS) solutions.

The Silverstream System cuts average net fuel consumption and greenhouse gas emissions by 5 to 10 percent, helping shipowners save fuel, lower emissions and reduce costs. The system achieves this by releasing a uniform carpet of microbubbles that coats the full flat bottom of a vessel, reducing friction between the hull and the water.

Collaboration to Build Maritime Tech Startups

Flagship Founders and Studio 30 50, two maritime technology venture studios, are combining their future venture-building activities under the Flagship Founders brand. The aim of this collaboration is to build the next generation of maritime technology companies in Europe and Southeast Asia with an unrivaled international partner network and teams in Berlin and Singapore. This will expand partnership and innovation opportunities for maritime industry players worldwide.

Venture studios build companies from scratch. This includes validating ideas for successful business models; finding the right founders; spinning off the startups; and providing ongoing support through operational and strategic resources, network access, and funding.

Flagship Founders is the only European venture studio focused exclusively on building technology startups for the maritime industry. The company has successfully built five companies, operating in emissions management, crew planning and ship inspections.

Columbia Group Leadership Development

Columbia Group, an integrated maritime, logistics, leisure, energy and offshore services platform, has announced an initiative to foster lifelong learning and growth in the company. The Leadership Development Programme, offered in partnership with global leadership consultancy FranklinCovey, aims to recognize and nurture leaders and build high-performing teams.

The program focuses on three groups: directors, line managers and future talents. Learning experiences, called "impact journeys," are designed to combine live interventions with digital support, including application challenges, to encourage using new skills in meaningful ways.

Elements of the program include: peer coaching sessions; accountability partners to help each participant follow through on goals; and individual development journeys to help increase self-awareness that can lead to better decision making, improved communication, conflict resolution, relationship building and better team work.

Hybrid Communication System

AST Networks is pioneering the integration of hybrid communication solutions to redefine maritime operational efficiency, safety, compliance and crew welfare.

By combining satellite (LEO/GEO), cellular and radio communications, hybrid systems ensure seamless connectivity and real-time accurate data exchange, even in the most remote, challenging environments. This integration reduces the risk of downtime, removes single points of failure and enhances overall cybersecurity, making maritime operations more resilient and secure.

Geotechnical Coring in Gulf of Mexico

TDI-Brooks has successfully executed a third-party geotechnical coring project for Geohidra in the southern Gulf of Mexico. TDI-Brooks conducted a total of 32 cone penetration tests (CPTs) using its Neptune 3000 miniature coiled rod CPT system, achieving penetration depths of 4 to 6 m in water depths ranging from 30 to 40 m.

Danelec Rebrands

Danish global marine safety and ship performance company Danelec has launched a new brand identity to mark the integration of recent acquisitions, including the Norwegian ship performance specialist Kyma AS, the VDR business of MacGregor, and the AI-based analytics platform Nautilus Labs.

BE LISTED!!



We have begun working on our 2025

Sea Technology Buyers Guide/Directory.

This annual digital publication, established in 1968, includes manufacturing firms, service organizations, engineering firms, construction companies, drilling companies, equipment lease and rental firms, and testing organizations involved in the many segments of the marine industry.

Current listees: Have you updated your industrial firm listing? Messages about these have been emailed.

If you're not listed in our 2024 edition (<https://lsc-pagepro.mydigitalpublication.com/publication/?m=60788&l=1&p=&pn=>) and would like to be included the next one, please click here <https://sea-technology.com/bg-listings> or contact Ann Barsotti at abarsotti@sea-technology.com by November 15.

The rebrand is designed to bridge the gap between the safety, performance, and digital technologies that serve the maritime industry today and the scalable data-centric solutions that will meet evolving future needs.

Shipowners and operators require not just data but actionable insights, and equipment manufacturers expanding their role in the maritime data value chain seek deeper, more meaningful analytics.

Institutional Investors Acquire US-Flag Operator

Institutional investors advised by J.P. Morgan Asset Management have acquired Bold Ocean LLC from its parent company, NOVA Infrastructure Management LLC. The new strategic ownership group will pursue growth opportunities to expand the company's U.S. flag fleet and logistical services. Dion Nicely, CEO of Bold Ocean, will continue to lead the company.

Headquartered in Annapolis, Maryland, Bold Ocean/Schuyler Line Navigation Co. is a U.S.-flag operator serving the critical transportation and logistics needs of U.S. government agencies. The company operates nine vessels that transport essential government supplies, fuel, humanitarian food aid and other goods under long-term time charter with the U.S. government.

Next Geosolutions Acquires Survey Company

Next Geosolutions Europe S.p.A., a marine geosciences and offshore construction support service company focused on renewable energies, has acquired 100 percent of the share capital of Subonica S.r.l., an ROV underwater survey and inspection company.

Subonica operates in the fields of offshore energy (renewable and traditional), submarine power cables, scientific research, environmental studies and monitoring, and underwater archeology.

New Hydrostatic Pressure Testing Facility

BIRNS has invested in a new extreme-depth hydrostatic pressure testing facility. It includes a custom-designed pressure vessel capable of tests to 20,000 psi (1,380 bar), features angular positioning, and can simulate sinusoidal motion. The facility enables technicians to utilize more than one testing vessel concurrently for greatly increased throughput.

The facility also allows for 48 hr. of continuous precision testing of connectors and cable assemblies at 6 km in a controlled 2° C (±1° C) environment.

Teledyne Gavia Expands

Teledyne Gavia has expanded its engineering and production facilities in Kopavogur, Iceland, to meet increased demand for Gavia AUVs and the larger Osprey and SeaRaptor AUVs. Teledyne Gavia has more than doubled the size of its manufacturing facility and has increased its staff in engineering, manufacturing, and support roles. Beyond Iceland, these enhancements will support service of the North American market in North Falmouth, Massachusetts.

Teledyne Gavia has also opened a Gavia AUV service center in Gdynia, Poland, set up by ENAMOR Ltd. **ST**

Network Upgrade for Rig Fleet

Marlink has announced two major upgrades for long-term customer Shelf Drilling. The first upgrade involves implementing a software-defined network management (SD-WAN) solution across Shelf Drilling's fleet of 36 jackup rigs. The second upgrade includes installing the high-bandwidth, low-latency Starlink solution on selected rigs currently operating in the Mediterranean and the North Sea.

Over the past decade, Shelf Drilling has progressively enhanced its satellite network solutions. This latest initiative will see the addition of Low Earth Orbit (LEO) services, including Starlink, where regional regulations permit. The rigs selected for the Starlink upgrade will benefit from improved crew welfare and enhanced communications.

The SD-WAN solution provided by Marlink will be deployed across the entire Shelf Drilling fleet, optimizing and managing network traffic to ensure high throughput and low latency. This hybrid network will combine guaranteed bandwidth services with cutting-edge technology to bolster digitalization efforts and seamless offshore connectivity.

The Starlink solution, serving as a secondary communications channel, will support client usage on board and further improve welfare services for the crew.

ITC Global, now a Marlink company, was awarded the first contract for communications services by Shelf Drilling in 2014, with renewals in 2018 and 2021. The award of the new contract will extend the relationship by another three years.

Cyber Resilience Guidelines

ClassNK has released Guidelines for Cyber Resilience of Ships, expounding on new International Association of Classification Societies (IACS) Unified Requirements (UR).

IACS has established UR E26 for ships and UR E27 for onboard systems and equipment. These URs set minimum requirements for cyber

resilience, which is the capability to reduce the occurrence and mitigate the effects of cyber incidents due to cyberattacks or other threats. The URs have been applied to new ships contracted for construction on or after July 1, 2024.

While incorporating these requirements in Part X of its Rules for the Survey and Construction of Steel Ships, which is about computer-based systems, and Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use, ClassNK has set up a portal site aggregating related information to support clients in responding to requirements relating to cyber resilience: www.classnk.or.jp/hp/en/activities/cybersecurity/ur-e26e27.html.

In the guidelines issued this time, guidance mainly for shipbuilders, shipowners and ship management companies is described. It covers the application scope of the rules, approval process, required documents and surveys. The guidelines are available to download on the portal site.

MAS Autonomous Navigation

The *Mayflower Autonomous Ship (MAS)*, a groundbreaking research vessel, will receive a significant enhancement to its navigational capabilities. This includes advanced radar processing software from U.K.-based Cambridge Pixel (*Sea Technology*, December 2023) to support a new Simrad radar. The upgrades, to be undertaken by unmanned vessel expert Submergence Group, also include the latest version of Guardian Autonomy from Marine AI.

The MAS project is developing a vessel capable of traversing the Atlantic Ocean autonomously, with no human intervention, while supporting scientific research and education. The project was inspired by the iconic journey of the original *Mayflower* from Plymouth, U.K., to the New World in 1620 and was started in 2019 as a collaboration between ProMare, IBM, and

a variety of industry and academic partners. It relies on cutting-edge technologies, including artificial intelligence and advanced sensor systems, such as radar, to navigate and make decisions in real time.

Cambridge Pixel's technology will enhance the situational awareness and safety of the autonomous ship, enabling it to navigate the high seas with precision and reliability. Its partnerships with leading radar manufacturers, including Simrad, enable its software to accept and convert proprietary data formats. The radar system upgrade will incorporate Cambridge Pixel's SPx Server application for advanced target tracking and SPx Fusion Server for the fusion of tracks from multiple onboard sensors. This helps the MAS detect targets of all sizes, ensuring safe navigation by providing accurate data to Guardian Autonomy, the AI-enabled collision avoidance system from Marine AI.

Beyond its autonomous capabilities, the MAS is equipped with an array of sensors and scientific instruments to collect data on oceanographic and environmental variables for research into climate change, ocean health, and marine biodiversity.

Battery for SF Ferries

The Swedish company Echandia has been selected to supply maritime battery systems for San Francisco (SF) Bay Ferry's Rapid Electric Emission Free (REEF) Ferry Program. This project will advance zero-emission water transit in the San Francisco Bay area.

As part of the REEF Program, San Francisco Bay Ferry will introduce a fleet of battery electric ferries, to be the first zero-emission high-speed ferries in the U.S. The first phase of this project includes the deployment of three 150-passenger ferries to operate on a network connecting emerging waterfront neighborhoods in San Francisco, and two 400-passenger ferries serving current SF Bay Ferry routes in Oakland and Alameda. The first REEF vessel is expected to enter service in 2026, with the initial battery systems scheduled for delivery in 2025. **ST**

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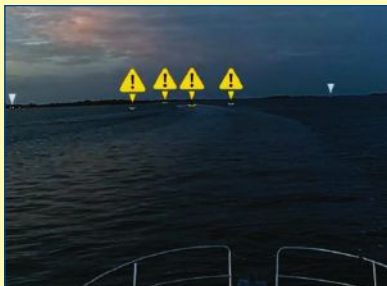


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AI for Navigation



The LOOKOUT camera system detects hazards beyond human capability using advanced computer vision algorithms to detect and track every marine hazard, such as other vessels, buoys, debris, whales, and people in the water. LOOKOUT combines data from charts, AIS, radar targets and online sources into a 3D augmented reality view. This reduces the captain's cognitive load and enhances situational awareness for better decision making. LOOKOUT.

Software Development Kit

SevenCs Nautilus 1.8 is the latest version of a development toolbox made to address the needs of original equipment manufacturers and system integrators to create their own Nautilus-based applications. Nautilus can process, render and display S-100 maritime data products in addition to the already supported military and S-57 data products. Nautilus also provides a technological platform for data installation, encrypting, updating and handling of S-100 standard charts. ChartWorld GmbH.

Power System

iC7-Hybrid ensures modular power systems for battery applications on board. These highly compact modules enable shipowners to effectively increase their installed power without increasing vessel size. The iC7 series offers emission reduction during all operational modes, as well as meeting the increasing demand for 50/60-Hz shore supplies

and high-power DC grid chargers for compliance with the 2030 regulation of vessels being powered from shore while berthed in port. Danfoss.

Industrial Computer

RM-2000-RTL is a shallow 2U computer (only 400 mm deep) that supports both redundant power and full-length, dual-slot graphics cards. It features a customizable brushed aluminum front panel; 14th Gen Intel Core Series CPU; 7x low profile or 2x full-height expansion slots; and redundant and 24-VDC PSU options. Steatite Ltd.

Mooring Snapback Solution



Defender Fuse and Defender Fuse with Surge Arrestor complement standard mooring systems and are easily positioned between the mainline and tail or between the tail and onshore connection. Defender Fuse comprises two types of rope. Once triggered, the load is transferred from the HMPE strength component to loops of a specially designed "catch" that elongates up to 150% more than the original length. This warns the crew to reduce load immediately. Samson Rope Technologies.

GHG Emissions Management

A new feature related to FuelEU Maritime has been added to the ClassNK ZETA (Zero Emission Transition Accelerator), a tool for visualizing greenhouse gas (GHG) emissions/CII ratings of ships and supporting management of EU-ETS. Users can monitor fuel oil con-

sumption, energy used, GHG emissions, GHG intensity, and more for the entire fleet and individual ships that are subject to FuelEU Maritime. Users can check surplus/deficit of compliance balance and manage banking, borrowing, and pooling. ClassNK.

Acoustic Emission Sensor



Part of the PREMET X range of two- and four-stroke diesel engine performance indicators, the new device enables engineers to monitor the acoustic signature of a diesel engine's fuel injection system to detect any problems with fuel injectors, nozzles, and pumps. Clogged or worn nozzles, leaking injectors, and damaged fuel pumps can affect fuel atomization and timing, leading to poor engine performance, increased fuel consumption, increased emissions and engine failure. CM Technologies GmbH.

Switching Mode Power Supplies

The HVPS Series is a line of solid-state DC power supplies for use with a wide range of high-precision industrial, military and scientific applications. They feature all solid-state construction and provide average power up to 250 kW, typical voltage regulation to $\pm 0.1\%$ and maximum voltage ripple of $< 0.1\%$, with up to 0.01% regulation and ripple below 0.001% , if required. Configured to application requirements, these monolithic units eliminate the complexity involved with connecting and controlling multiple smaller switching power supplies. Diversified Technologies Inc.

Proactive Fleet Maintenance

The Vessel Performance Monitor provides the underlying impact of hull and propeller conditions on

the propulsion efficiency of vessels, empowering performance and technical teams to make timely operational and maintenance decisions, potentially improving fuel efficiency by at least 3% (results may vary). My Digital Fleet (MDF) is powerful and secure fleet performance software that combines comprehensive operational data with environmental, class, and regulatory insights from ABS to quantify risk and make decisions with confidence. The platform enhances operational efficiency, achieves fleet decarbonization goals and streamlines compliance. ABS Wavesight.

Hydrogen Sealing Compounds

The H₂Pro range of more than 20 sealing compounds applies to every application of the hydrogen value chain. Designed to accelerate innovation for sustainable technology, the H₂Pro range has solutions for the challenges of hydrogen production, transport and storage, and end-use. Proven to withstand challenging application environments,

the materials are suitable for high pressures and low temperatures, and resist permeation, making them better able to withstand rapid gas decompression while demonstrating excellent wear and extrusion properties. Trelleborg Sealing Solutions.

Predictive Maintenance

Cloud-based service V-MO enables predictive maintenance of ocean vessel motors by detecting signs of abnormalities. When a potential failure is predicted, repairs can be arranged before the vessel arrives at port. This allows for prompt repairs, improving operational efficiency. Asahi Kasei Engineering.

Maritime Internet

Flexible Starlink LEO internet plans allow customers in maritime, on-shore and offshore energy, enterprise, and leisure boating industries to benefit from a range of bespoke connectivity plans, from 10 GB to unlimited data, depending on their needs. Marlink. **ST**

SEA TECH e-NEWS

Featuring the government and industry news you need to know, Sea Tech e-News delivers timely information straight to your inbox, with details on recent product releases, updates on new hires and promotion, and workshops. We send out the newsletter every other week, so you'll get a steady stream of news edited down to what matters most.

Methane Slip Prevention

Daphne Technology's innovative SlipPure system has been awarded approval in principle (AiP) from Lloyd's Register for its plasma-catalytic technology, with LR-witnessed results confirming its performance.

The SlipPure system, which previously received AiP for its plasma-only configuration, now runs its full plasma-catalytic process, which improves efficiency by lowering plasma power consumption, enabling very high methane slip reductions at exhaust temperatures well below those required for catalyst-only solutions. The system is also approved in principle by DNV.

Methane slip is a major contributor to greenhouse gas emissions, with a global warming potential 28 times greater than that of CO₂ over a 100-year period.

SlipPure integrates the patented wavelet pulse power supply technology to generate plasma and utilizes a proprietary catalyst. The system has undergone rigorous test campaigns utilizing exhaust gas produced from a land-based test engine installed at the Maritime Center of the University of Applied Science in Flensburg, Germany.

Subsea Volcanology

MacArtney has announced a partnership with Elettra Tlc to deliver critical subsea infrastructure for the Italian National Institute of Geophysics and Volcanology (INGV), enhancing its capacity for environmental monitoring and research.

The scope of this collaboration involves installing and connecting a new subsea power, communication and data transmission network located 2,200 m deep and 35 km offshore from Catania, Italy, where INGV will manage its existing marine site as part of the ITINERIS project (Italian Integrated Environmental Research Infrastructures System).

Elettra will supply the main electro-optical submarine cable, ensure robust connections, and manage the installation and testing of the complete system at the operating

site. MacArtney will provide the cable termination assembly and a customized cable termination frame (CTF) as integral components of an advanced subsea sensor platform. The CTF serves as both a distribution hub and connection point for the sensor platform, allowing for seamless integration of scientific instruments into the power network and efficient data transfer to and from the ground station, utilizing hybrid Teledyne ODI penetrators and ROV-mateable connectors. At the heart of this platform is the medium-voltage conversion system and PBOF (pressure-balanced, oil-filled) transformer canister.

The scope also includes a power supply and control system, a remote management system for INGV's operational oversight and maintenance, and factory and site acceptance testing to check and verify compliance with the preapproved specifications.

Together, Elettra and MacArtney enhance INGV's capacity to monitor and study environmental processes in southern Italy and Sicily, regions known for seismic and volcanic activities. As a key contributor to the ITINERIS project, INGV will be able to install new multidisciplinary submarine observatories (including oceanographic, geophysics and seismic sensors) on the slopes of the Etna volcano in the southern part of the Messina Strait. This will provide access to unprecedented deep-sea experiments for the next 20 years.

Low-Pressure CO₂ Ship Transport Chain Is Feasible

The CO₂ Efficient Transport via Ocean (CETO) joint industry project has concluded with a report on the findings of the technology qualification performed in the study. The project partners, which included Equinor, Gassco, Shell, TotalEnergies and DNV, have found no technological barriers to a low-pressure CO₂ ship transport chain.

For carbon capture and storage (CCS) to play a significant role in re-

ducing emissions, transporting large amounts of CO₂ will be vital. Pipelines will be an option, but where the capture source and storage sites are unable to be easily connected, ship transport will be crucial. To achieve the scale required for commercial viability, low-pressure ship solutions (approximately 7 bar at -49° C) are regarded as an attractive option.

CETO demonstrated that shipping of CO₂ at low-pressure condition is feasible and that the technology is ready for first use. The activities showed that a dedicated LCO₂ carrier could be designed according to the relevant international rules and regulations. The testing campaign on a medium-scale pilot plant demonstrated that cargo handling operation in the range of 6 to 9 barg could be carried out without dry ice formation.

There are aspects of the transport chain that will require particular attention during project development, such as material selection for cargo tanks, fatigue and sloshing loads.

'Precautionary Pause' for Deep-Sea Mining

Malta, Tuvalu, Honduras, Guatemala and Austria have committed to a precautionary pause on deep-sea mining at a recent International Seabed Authority meeting in Kingston, Jamaica.

The exact commitments made vary in detail, but they all espouse a precautionary approach. For instance, Guatemala called for deep-sea mining not to commence until regulations for mining are agreed upon, while Tuvalu called for it not to start until there is demonstration of no risk of harm to the ocean.

The European Parliament, the European Commission, the United Nations High Commissioner for Human Rights, scientists, financial institutions, indigenous communities, environmental organizations, and companies such as BMW, VW, Samsung, and Google also call for a halt to deep-sea mining.

You can learn more about the current state of deep-sea mining in the opening editorial of *Sea Technology's* September 2024 issue. **ST**

New Partner for Ocean Census

The Nippon Foundation-Nekton Ocean Census, a global initiative dedicated to discovering marine life (*Sea Technology*, January 2024), has partnered with the Senckenberg Society for Nature Research. This cooperation is poised to significantly enhance efforts in understanding and protecting marine biodiversity, combining the Ocean Census's innovative methods with Senckenberg's extensive natural history collections and taxonomic expertise.

The Ocean Census, launched by The Nippon Foundation and Nekton in April 2023, aims to accelerate the discovery of marine life. With an estimated 1 million to 2 million species in our ocean, only a small portion—about 10 to 25 percent—has been documented. Historically, marine species have been identified at a steady pace of 1,500 to 2,000 per year since the 1850s. However, advancements in imaging, DNA sequencing and artificial intelligence (AI) now promise to dramatically accelerate this rate.

Senckenberg has eight institutes in Germany and is one of the leading research institutions on biodiversity in that country. Senckenberg's marine research includes initiatives such as the Senckenberg Ocean Species Alliance.

The new partnership will involve joint expeditions, knowledge sharing and public engagement. The partnership will also innovate, test and deploy new technologies to enhance species discovery, including DNA sequencing, 3D imaging and AI-driven data analysis.

USV to Monitor Hypoxia

Utilizing autonomous uncrewed vehicles and creating a sustainable U.S. Gulf Coast continues to be one of the main goals for The University of Southern Mississippi (USM) and its partnership with SeaTrac Systems. Together, they embarked on a 14-day mission to analyze potential hypoxia levels in the Gulf and its effect on the future of marine life. Also known as dead zones, hypox-

ia zones are areas in which oxygen levels in water are decreased due to nutrient pollution caused by runoff rich in nitrogen and phosphorus. Helping these zones regain oxygen levels entails decreasing nutrient levels through better agricultural practices, improving wastewater treatment, and watershed management strategies.

The partnership, which also includes NOAA's Office of Marine and Aviation Operations, sought to act swiftly to map the potential hypoxic zones in the Gulf by using SeaTrac's SP-48 USV. The remotely operated vessel gathered 24/7 real-time data and demonstrated sampling procedures and winch for profiling applications.

During the project, SeaTrac personnel based in Marblehead oversaw the remote data collection and mapping. The USV transmitted data from sensors over cellular and satellite connections to servers at USM. The mission set a precedent for greater spatial and temporal data collection enabled by autonomy.

USM and NOAA scientists boarded a research vessel nearby to collect and compare data gathered via a crewed vehicle to that of SeaTrac's SP-48.

SeaTrac relies on natural energy from the sun to power its uncrewed systems in ocean waters. Through this energy-saving process, researchers can collect data efficiently and sustainably.

The partnership continues to solidify the region's commitment to a sustainable Mississippi Gulf Coast.

Video Footage from Sea Lions Enhances Benthic Research

Researchers in Australia have enlisted endangered Australian sea lions (*Neophoca cinerea*) to carry video cameras that enable the identification of previously unmapped benthic habitats used by the sea lions on the continental shelf. The results have been published in *Frontiers in Marine Science*. For the project, supported with funding from the Australian government and

the Ecological Society of Australia, eight adult female Australian sea lions from Olive Island and Seal Bay colonies were equipped with small, lightweight cameras, which, along with GPS trackers, were glued to small pieces of neoprene that were then glued to the fur of the sea lions. Recordings were made over two to three days.

From 89 hr. of recordings in total, the researchers identified six benthic habitats: macroalgae reef, macroalgae meadow, bare sand, sponge/sand, invertebrate reefs and invertebrate boulder. The researchers then used machine learning models incorporating 21 years of observation and measurements to predict large habitat areas across the continental shelf of southern Australia.

American Samoa Expedition

The Ocean Exploration Trust's EV *Nautilus* has completed the 18-day expedition "E Mamana Ou Gataifale I" (NA164). This expedition included multi-vehicle exploration of midwater ecosystems across American Samoan waters.

The midwater ocean twilight zone is an important source of food for many marine animals, including commercial species, such as tuna and swordfish. This expedition explored this zone in priority areas identified by the American Samoan management and science community.

The expedition, funded by NOAA Ocean Exploration via the Ocean Exploration Cooperative Institute, visited Vailulu'u Seamount in the National Marine Sanctuary of American Samoa and other seamounts to learn more about how open ocean and seafloor habitats interact.

Vailulu'u Seamount is the only hydrothermally active seamount in American Samoa.

The Woods Hole Oceanographic Institution's hybrid remotely operated vehicle Mesobot and the University of Rhode Island's Deep Autonomous Profiler Lander were deployed from the ship, and the University of New Hampshire's DriX USV was operated from shore in Pago Pago for the expedition. **ST**

contracts

Wallem Group, Hong Kong, China, has signed a strategic cooperation agreement to work together toward common goals on green, low-carbon and intelligent shipping, and to leverage respective strengths to further integrate resources and jointly enhance competitiveness in ship management. COSCO Shipping Seafarer Management Co.

Ocean Technologies Group (OTG), London, U.K., will supply eLearning courses as part of a three-year contract, with the option of two-year extension, that will provide on-demand remote training content for marine surveyors covering the basics of MARPOL regulations, enclosed space entry awareness and ship security officer training. U.K. Maritime and Coastguard Agency.

Forcys, Yateley, U.K., has been selected as a payload provider for the completely solar- and wind-powered AUSV Triton. Forcys will supply the SPRINT-Nav Mini INS and Solstice multi-aperture sonar. Ocean Aero.

Greenwater Marine Sciences Offshore, Arlington, Virginia, has partnered with a team to secure a Pro-Tech contract for five to 10 years. This contract allows competition for individual tasks and projects within NOAA's Oceans Domain. NOAA.

Teledyne Benthos, North Falmouth, Massachusetts, has been awarded a \$975,000 grant to advance on-demand, or ropeless, fishing technology. Ropeless fishing provides lobster and crab fisheries a means to recover fishing gear remotely, through subsea acoustic communication, thus reducing, or removing, the need for ropes, lines, and surface buoys. U.S. National Fish and Wildlife Foundation.

Equinor, Stavanger, Norway, will convert the *Viking Energy* supply vessel to ammonia operation. The vessel supplies Equinor's installations on the Norwegian Continental

Shelf. This will be the world's first supply vessel fueled by ammonia. Eidesvik Offshore.

Opsealog, Marseille, France, has been awarded a two-year contract with Angola's largest independent energy company to reduce fuel consumption and greenhouse gas (GHG) emissions from its offshore supply vessel fleet. Through enhanced data collection, integration and analysis, the project could reduce the fleet's GHG emissions by up to 10 percent. Azule Energy.

Telemar, Oslo, Norway, will provide safety maintenance services on a growing fleet. The contract applies to GMDSS and navigation safety installations on newbuilds that will boost ferry services in the Mediterranean and beyond. GNV (Grandi Navi Veloci).

Silverstream Technologies, London, U.K., has received an order for its air lubrication system, Silverstream, to be installed on board 18 new 271-kcbm QC-Max-class LNG carriers, to be chartered by a global energy company and owned and operated by shipping majors. Undisclosed. **ST**

meetings

NOVEMBER

November 4-7—EURONAVAL, Paris-Nord Villepinte, France. www.euronaval.fr.

November 5-6—Sustainable Ocean Summit, Barcelona, Spain. www.sustainableoceansummit.org.

November 5-7—Deepwater Operations and Topsides, Platforms & Hulls Conference and Exhibition, Galveston, Texas. offshore-event.com.

November 7-10—Europort, Rotterdam, Netherlands. www.europort.nl.

November 12-14—International WorkBoat Show, New Orleans, Louisiana. www.workboatshow.com.

November 18-20—CLEAN GULF, Houston, Texas. www.cleangulf.org.

November 18-21—BlueTech Week, San Diego, California. bluetechweek.org.

November 19-21—Marine Renewables Canada Conference, Halifax, Canada. <https://marinerenewablesconference.ca>.

November 19-21—MAST Australia, Adelaide, Australia. mastconfex.org.

November 20-21—Decarbonisation in Shipping Europe, Hamburg, Germany. www.wplgroup.com/aci/event/decarbonisation-shipping-europe.

November 26-27—Offshore Energy, Amsterdam, Netherlands. www.offshore-energy.biz.

DECEMBER

December 9-13—AGU Annual Meeting, Washington, D.C. www.agu.org/annual-meeting.

December 9-13—Chesapeake Technology SonarWiz Training, Nashville, Tennessee. <https://chesapeake.tech.com/wp-content/uploads/2024/09/2024-12-Workshop-Agenda-1.pdf>.

December 12-13—Marintec Innovation Conference, Shanghai, China. www.marintecchina.com.

2025

JANUARY

January 15-17—Floating Wind Solutions, Houston, Texas. <https://floatingwindsolutions.com>.

FEBRUARY

February 10-12—Geo Week, Denver, Colorado. www.geo-week.com.

APRIL

April 8-10—Interspill, London, U.K. www.interspill.org.

For more industry meetings, visit sea-technology.com/meetings. **ST**

people

Teledyne RD Instruments (RDI) has appointed **Dr. Sarah Ruth Merrigan** as technical service and support engineer. She will be based out of RDI headquarters in Poway, California, and will enhance global support of ADCPs and DVLs. Merrigan has a strong background in civil engineering, physical oceanography, water resources and hydrology, with a B.S. and M.S. from the University of Arizona and a Ph.D. from the University of California, Irvine.



Dr. Claus Reimers, formerly deputy chief technology and innovation officer at Lloyd's Register, has joined Akselos as chief product and technology officer. He will drive Akselos' innovation and product strategy, integrating product management with technological advancements. Akse-

los protects critical infrastructure, including floating FPSO vessels, downstream facilities and floating offshore wind, via near-real-time structural health monitoring.

Pier Solutions has appointed **Gary Gallon** as managing director of its recently acquired electrical engineering businesses, V-TES and V-TES Renewables, as it strengthens its service offering across the energy sector. Galon has extensive experience in various commercial roles, including 12 years at Dron & Dickson, where his last role was engineering manager. He will support onshore and offshore customers.

Jens Lorens Poulsen has moved from his position as group CEO of Marcura, a maritime solutions provider, to the role of chair of the board. **Henrik Hyldahn**, previously the CEO of ShipServ, a maritime online procurement platform recently acquired by Marcura, has transitioned to group CEO.

The U.S. Office of Naval Research (ONR) Global has promoted **Dr. Marcus Tepaske** to technical director. He will lead experts in finding cutting-edge technologies and solutions and getting them into the field. Tepaske previously served as an ONR Global science director in Singapore from 2022 to 2024.

Smart Ship Hub Digital (SSH), a fast-growing maritime digital platform for shipowners, operators, charterers and insurers, has appointed **Uday Bhaskarwar** as its chief growth officer. He brings a wealth of experience in driving growth and operational efficiency, honed through senior leadership roles at global technology firms and successful startups.

The Nautical Institute has welcomed **Captain Trevor Bailey** as president. He takes over from **Captain André LeGoubin**. Bailey will represent the interests of the members of The Nautical Institute, a shipping industry NGO with consultative status at the International Maritime Organization.

The World Ocean Council (WOC) has announced **Donna Lanzetta**, CEO of Manna Fish Farms, as the new chair of the board of directors. She takes over from the outgoing board chair, **Philipp Hermes**, director at Tethys Naval. Lanzetta is an attorney and entrepreneur dedicated to sustainable seafood production.

The Oil Companies International Marine Forum (OCIMF) has appointed bp's Senior Vice President Shipping **Lambros Klaoudatos** as its new chair. He is a highly experienced maritime professional with almost 30 years of industry experience across technical, commercial, project management, and leadership roles at sea and onshore.

The National Marine Representatives Association has awarded four scholarships of \$1,000 each to students pursuing education in the marine trades beginning this fall. The 2024 recipients are: **Aven Frank**, attending Northwood Technical College; **Ben McQueen**, attending Great Lakes Boat Building School; **Memphis Ford**, attending Lake Careers & Technical Center; and **Zach Boyer**, attending IYRS School of Technology & Trades. **ST**

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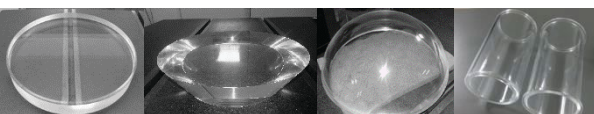
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Tech Companies Must Engage Citizens in Climate Response—Dr. Richard Burroughs

Dr. Richard Burroughs is a professor who teaches at the Department of Marine Affairs at the University of Rhode Island. His book, "Coastal Governance"



(Island Press), describes potential pathways for how human uses of the coast and ocean can be managed for the benefit of all. He holds a Ph.D. in oceanography from the Massachusetts Institute of Technology and Woods Hole Oceanographic Institution.

Increases in sea level rise and storms elevate water levels episodically and, ultimately, permanently in coastal cities. What New Orleans is today—stabilized by a network of levees and pumps—Charleston and portions of New York will become in time.

Many of our major cities, if they stay where they are and function as they do now, will need technologies to respond as water level edges above the ground surface with sea level rise. These technologies will inform us of the where and how of episodic and permanent sea elevation and enable the prevention of flooding or removal of water.

Citizens can either pay for the technologies to protect the city where they live, or choose the option to leave. With this choice, they can control outcomes. Climate change mandates deep civic involvement in data collection, analysis, planning and response, which requires outreach by technology companies to citizens.

Instrumentation to understand the causes and process of inundation in a city will be a crucial first step. These instruments should measure local rain, river and sea flows; surface waters; drainage system flows; groundwater elevation; and other phenomena.

Currently, cities in the developed and developing world monitor and anticipate local water levels and

use the data to warn inhabitants of events. At the national scale, weather services utilize radar, rain and stream gauges to identify floods. At the global scale, the United Nations Intergovernmental Panel on Climate Change provides insights on sea level, precipitation and storms, with increasing attention to regional and individual city details.

A possible future scenario could involve streetlamps equipped with microwave sensors to detect surface water elevation, for example, during sunny day flooding or king tides. The data would contribute to knowledge of the flows and volumes causing city surface water elevations, which would lead to interim solutions. Important data are also likely to come from acoustic Doppler systems to monitor water in the rivers, canals and pipes that interlace cities.

In addition to sea level rise, cities must contend with sinking caused by geologic and anthropogenic change. Time series data from synthetic aperture radar can be used to calibrate the rate and location of land elevation change in a city. Pumping drinking water from beneath the city can be related to observed elevation change. Combining local sea level rise and city sinking data, perhaps at the city block scale, will enable citizens and municipalities to better understand the risks they face.

As water rises and spreads into coastal cities, it affects lives, livelihoods and the survival of the city as an economic engine. Thus, citizens must be involved in action, and technical information must be publicly available. If tech companies involve citizens throughout efforts to respond to rising seas, such initiatives will become more effective.

Websites could document the location of rising waters via cell-phone pictures with time and location data, for example. The data could then be tied in with sensors

for water level, salinity and related flow velocities to identify causes. These publicly available websites could map inundation and water flow and communicate causes so citizens can better understand their environment.

IBM, Cisco, Siemens, Microsoft and other corporations are already involved in instrumenting smart cities, a process that requires even more software firms and instruments supporting the systems. These firms, however, have not focused on getting necessary buy-in from the people who live in these cities.

An alternative is moving the city or some of its functions. For example, Indonesia plans to relocate its capital from Jakarta to Nusantara. Moving is not a typical choice, however, which means that engineering solutions to increasing storms and sea level rise remains the focus.

Ultimately, understanding climate change and creating solutions will fail if citizen buy-in is lacking. Taxes paid by citizens finance implementation at various levels of government, and climate-related initiatives will compete with other budgetary needs.

For instance, sea walls for Boston, New York, Charleston and elsewhere, if implemented, are expensive. Properly designed and maintained walls have proven technically viable, but with federal funding more readily available for disaster recovery, at least for now, political will and monies for prevention are inadequate. Ignoring or delaying holistic solutions increases the vulnerability of cities.

Responses to climate change must be part of a peopled technology process. Companies supplying environmental monitoring technologies need to invite citizens to become deeply engaged in data gathering and decision making. Meaningfully connecting technology and people promotes sustainable cities in the face of sea level rise. **ST**

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A photograph showing a person in a blue inflatable kayak on a river. The person is wearing a black helmet and a blue jacket. The kayak is blue with a white stripe. Another person in a black kayak is visible in the background. The river is surrounded by green foliage and a wooden fence.

